MAR 2 1925

PROCEEDINGS

of the

American Society

of

Civil Engineers

MARCH, 1925

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JULY 8-10, 1925

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Standard Specifications for Concrete and Reinforced Concrete: Report of Joint Committee on Standard Specifications for Concrete and Reinforced Concrete	Oct., 1924, Jan.,	"	Uncertain
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PROCEEDINGS

of the

American Society

of

Civil Engineers

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VOL. LI MARCH, 1925 No. 3

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AMERICAN SOCIETY OF CIVIL ENGINEERS

PROCEEDINGS

VOL. LI MARCH, 1925 NO. 3

SOCIETY AFFAIRS

Annual Meeting, 1925

Probably the average member attending Society meetings would vote one "just like any other". So with the 1925 Annual Meeting—and yet it was different, and better—not in any outstanding event or special detail, but in its uniform excellence, its smooth conduct, and its good fellowship.

At the morning session of the Annual Meeting, on Wednesday, January 21, 1925, the awarding of prizes and of Honorary Membership to Herbert Hoover, M. Am. Soc. C. E., shared in popularity with the induction of the new President, Mr. Robert Ridgway. In the afternoon, ample time was given for delivering and discussing the reports of Special Committees. The discussions on Stresses in Structural Steel and on Standard Construction Contracts were especially complete. Many of the reports are printed elsewhere in this number of *Proceedings*.* Of especial merit is that on Stresses in Railroad Track, which because of its magnitude is deferred for printing to the April *Proceedings*. Between the two sessions, lunch was served on the fifth floor of the Engineering Societies Building. Many interesting comments on this old but always enjoyable feature were heard; the service was prompt, the food good, the price reasonable, and above all the added opportunity for "visiting" and the avoidance of the usual scattering of those in attendance seemed greatly appreciated.

The growth in size and number of the Technical Divisions has brought new problems in arranging for their meetings. The Technical Sessions of the Power, City Planning, Highway, and Sanitary Engineering Divisions and the organization of the Structural Division constituted the program for Thursday, January 22. The Sanitary Engineering Division held an attractive all-day meeting at the Pennsylvania Hotel including a luncheon jointly with the New York Section of the American Water Works Association.

As usual, the President's and Honorary Members Reception and Dinner Dance on Wednesday evening in the Grand Ball Room of the Pennsylvania Hotel proved the banner attraction. At the entrance, in the receiving line, were the newly elected and retiring Presidents and the Secretary, with their ladies. At the conclusion of the dinner the Singers Club of New York—a

* See Society Affairs, p. 126; and Papers and Discussions, p. 392.

male chorus—gave a half hour of excellent music. During and following the meal, Woolfsies Orchestra furnished music, also of fine quality, until the small hours. This whole function was without a flaw, judging from comments.

Of a different sort, but fully as well received was the entertainment and Smoker on Thursday evening, at which the attendance comfortably filled the Auditorium floor and gallery. The humor and satire of the "artists" is beyond capacity of printer's ink. As its first "act" the meeting entertained the Annual Convention of the "Amalgamated Order of What-Not Engineers" including the granting of prizes to a theorist on the "removal of manhole covers," to a "Practical Engineer" and to an "Exterminating Engineer". The latter part of the program was a humorous illustrated talk by Mr. Alan M. E. Johnstone entitled "The Treatment of Water." At its conclusion, members and guests adjourned to the Fifth Floor and enjoyed two hours of smoking and sociability.

Especially fortunate was the choice of the all-day excursion to West Point and Bear Mountain, N. Y., by special train *via* the West Shore Railroad. After almost two hours at the Military Academy viewing the quarters, classrooms, gymnasium, laboratories, museums, and chapel, the party returned to Bear Mountain Inn for the afternoon. The Bear Mountain Inn was ideal for the occasion, and following luncheon members of the party amused themselves with skating, tobogganning and dancing. Many inspected the recently completed suspension highway bridge across the Hudson close by. All regretted to leave at 4:00 P. M. for the return to New York as the crisp air and deep snow lent a real seasonal flavor to the day.

In the evening, as a final event of the program, a series of College Reunions was held as follows: Brown Engineers at the Brown University Club; Cornell Engineers at the Hotel Pennsylvania; Yale-Harvard-Princeton Engineers (Smoker) at the Yale Club; Lehigh Engineers at the Machinery Club; and Pennsylvania Engineers at the Pennsylvania Club. (The Thayer Society Engineers of Dartmouth College held their dinner on Tuesday evening, January 20, 1925).

An innovation was introduced at this meeting in planning special entertainment for visiting ladies. This included a Bridge and Tea on Wednesday afternoon at the Hotel Pennsylvania, shopping tours on Thursday morning, sightseeing trips on Thursday afternoon, and a theater party Thursday evening. The ladies who availed themselves of these pleasures were enthusiastic. As a pioneer effort it will serve as a basis for developing this new feature and making it an increasingly valued part of future meetings.

The attendance at the various sessions was approximately as follows: Annual Meeting: Morning, 400; lunch, 400; afternoon, 200. Division Meetings: Sanitary Engineering—Morning, 75; afternoon, 50. City Planning—Morning, 35; afternoon, 30. Power—Morning, 85. Structural—Morning, 100; afternoon, 100. Highway—Morning, 75; afternoon, 60. Reception and Dinner Dance, 475. Smoker, 750. Excursion, 350.

Considering the severe winter conditions of the month of January, the weather during the entire Annual Meeting was exceptionally good.

No account of the meetings can be complete without acknowledgment of the admirable arrangements to the smallest detail, which gave a precision and finish to all the sessions. To the members and ladies on the Committees in charge of the arrangements is due the gratitude of every member who attended the Seventy-second Annual Meeting of the Society.

Annual Business Meeting of the Society

The Seventy-second Annual Meeting of the Society was called to order shortly after 10:00 A. M., on January 21, 1925, by President Grunsky. Routine business matters were considered; Tellers were appointed; reports were read from the Board of Direction, the Secretary, and the Treasurer. The meeting stood a few moments in silence to the memory of deceased officers and members. Honorary membership was bestowed on Herbert Hoover, M. Am. Soc. C. E., who in response expressed his appreciation. Medals and prizes were awarded as follows: Norman Medal to B. F. Jakobsen, M. Am. Soc. C. E. (represented by H. D. Dewell, M. Am. Soc. C. E.), J. James R. Croes Medal to Joel D. Justin, M. Am. Soc. C. E. (represented by F. W. Scheidenhelm, M. Am. Soc. C. E.), the James Laurie Prize to Charles M. Allen, M. Am. Soc. C. E. and I. A. Winter, Esq., and the Arthur M. Wellington Prize to Rufus W. Putnam, M. Am. Soc. C. E. Reports of the Alfred Noble Memorial Committee and of the Columbia University Scholarship Committee were submitted. The thanks of the Society were voted to the Alabama Power Company for cooperating in the publication of the Society's paper on "Comparative Tests on Experimental Draft-Tubes".* After the report of the Tellers† the new President, Robert Ridgway, was presented and responded to the applause.

After a recess for lunch, the meeting continued about 2:30 P. M., President Ridgway presiding, to hear reports of Special Committees. The Special Committee on Impact in Highway Bridges‡ reported through its Chairman, Almon H. Fuller, M. Am. Soc. C. E. Extended discussion ensued over the Final Report of the Special Committee on Stresses in Structural Steel§ in which the following members participated, Messrs. F. O. Dufour, L. D. Rights, Clement E. Chase, A. N. Talbot, H. B. Seaman, D. B. Steinman, Clyde T. Morris, F. E. Schmitt, Anson Marston, Shortridge Hardesty, and J. A. L. Waddell. The Committee requested dismissal, but the final action was simply to receive the report. The Special Committee to Codify Present Practice on the Bearing Value of Soils for Foundations, etc., reported orally through E. G. Haines, M. Am. Soc. C. E., one of its members, who made a strong appeal to members to support the Committee by responding to requests for information on soils. A. N. Talbot, Past-President, Am. Soc. C. E., briefly summarized the report of the Special Committee on Stresses in Railroad Track, which, as previously stated, will be published in full in April, 1925, *Proceedings*. The Special Committee on Standard Construction Contracts through J. S. Langthorn, M. Am. Soc. C. E., Chairman, in its report

* *Transactions*, Am. Soc. C. E., Vol. LXXXVII (1924), p. 893.
† See Society Affairs, p. 65.
‡ See Society Affairs, p. 126.
§ See Papers and Discussions, p. 392.

submitted forms of standard contracts.* This report was fully discussed by Messrs. R. C. Marshall, Jr., E. J. Mehren, and W. B. Bamford. The Chairman of the Special Committee on Concrete and Reinforced Concrete Arches, C. T. Morris, M. Am. Soc. C. E., described its report,† which was accepted. Charles F. Loweth, Past-President, Am Soc. C. E., reported progress for the Special Committee on Electrification of Steam Railways. The report on Flood Protection Data‡ was presented for the Committee by Gerard H. Matthes, M. Am. Soc. C. E., and discussed by T. H. Wiggin, M. Am. Soc. C. E. The report of the Special Committee on Irrigation Hydraulics§ was read by title. S. M. Woodward, M. Am. Soc. C. E., Chairman of the Special Committee on Hydraulics Phenomena, presented its report,‖ as did F. E. Turneaure, M. Am. Soc. C. E., Chairman, for the Special Committee on Steel Column Research. The foregoing reports, together with one of progress from the Special Committee on Bridge Design and Construction, were received by the meeting as presented. Adjournment was voted at about 5:00 P. M.

Meetings of the Board of Direction

These are abstracts of the notes of the Secretary and subject to approval by the Board of Direction at its next meeting.

Meetings of January 19 and 20, 1925

The Board of Direction met at Society Headquarters on January 19 and 20, 1925, the following being in attendance: President C. E. Grunsky; Secretary George T. Seabury; and, also, Messrs. Brown, Chester, Condron, Davison, Farnham, Fenkell, Freeman, Holmes, Howe, Huber, Loweth, Marston, Mason, Merriman, Paul, Webster, Whitman, Winsor, Yates, and Treasurer Hovey.

Annual Report of the Board of Direction:

After discussion, the Annual Report¶ of the Board, as prepared by the Executive Committee, was adopted.

Arizona Section Authorized:

The formation of a Local Section for the State of Arizona was approved, and the Executive Committee was given authority to approve the Constitution of the Section after its organization.

New Student Chapters Authorized:

On recommendation of the Committee on Student Chapters, authority was granted for the formation of Student Chapters at the University of Georgia and at the Armour Institute of Technology. The question of setting aside

* It is expected that this report will be published in a subsequent number of *Proceedings*.
† See Society Affairs, p. 129.
‡ See Society Affairs, p. 135.
§ See Society Affairs, p. 137.
‖ See Society Affairs, p. 161.
¶ See Society Affairs, p. 84.

special space in *Proceedings* for data relating to Student Chapters was referred to the Committee on Technical Activities and Publications for consideration. Members of Student Chapters were also granted the same discount allowed to members in the purchase of *Transactions*.

Re-organization of Federal Departments:

The following resolution was adopted regarding the formation of a Department of Public Works:

"The Board of Direction of the American Society of Civil Engineers hereby reaffirms its former expressions of approval of the formation of a Department of Public Works in which, so far as possible, all activities of the Federal Government having to do with engineering and construction shall be grouped.

"This Board also expresses its belief that the best interests of the country will be served by divorcing military and non-military activities and placing the latter class, where of proper nature, in a Department of Public Works.

"These expressions of the Board of Direction are offered for the guidance of any committees which shall be sent to Congress to represent it in connection with legislation there pending."

Committee on Arbitration:

The work of the Arbitration Society of America was described as outlined to the Joint Conference Committee by Judge Moses H. Grossman. In accordance with the recommendations of that Committee, the following motion was carried:

"That the President be authorized to appoint a Committee to consider this matter of arbitration and report back to the Board and that in the meanwhile the Committee be authorized to confer with similar committees of other Societies."

Members Asked to Support Temple Bill:

The Secretary was authorized to prepare a statement in *Proceedings** outlining the provisions of the Temple Bill now before Congress, providing for the completion of the topographic mapping of the United States in twenty years, and to ask members to urge the passage of the Bill by getting in touch with their representatives in Congress.

Amendments to By-Laws Adopted:

The following proposed amendments to the By-Laws of the Society were adopted:

(1) Article IV, Section 7, which now reads:

"*Reports.*—Each special committee shall make either a progress or final report of the work accomplished by it during the year, for presentation to the Annual Meeting. The reports of special committees shall be filed with the Secretary of the Society at least 60 days before the Annual Meeting."

to read as follows:

"*Reports.*—Each special committee shall make either a progress or final report of the work accomplished by it during the year, for presentation during

* See Society Affairs, p. 66.

the week of the Annual Meeting. The reports of special committees shall be filed with the Secretary of the Society at least 60 days before the Annual Meeting."

(2) Article VI, Section 2, which now reads:

"2.—The order of business at meetings of the Society unless otherwise provided shall be as follows:

"ANNUAL MEETING:

Appointment of Tellers to Canvass Ballot for Officers.
Report of the Board of Direction.
Report of the Secretary.
Report of the Treasurer.
Reports of Special Committees.
Announcements and Reports by the Secretary.
Report of Tellers to Canvass Ballot for Officers.
New Business.

"REGULAR BUSINESS MEETING:

Minutes.
Announcements by the Secretary.
New Business.
Presentation of Papers."

to read as follows:

"2.—The order of business at meetings of the Society unless otherwise provided shall be as follows:

"ANNUAL MEETING:

Appointment of Tellers to Canvass Ballot for Officers.
Report of the Board of Direction.
Report of the Secretary.
Report of the Treasurer.
Announcements and Reports by the Secretary.
Report of Tellers to Canvass Ballot for Officers.
New Business.

"REGULAR BUSINESS MEETING:

Minutes.
Announcements by the Secretary.
New Business.
Presentation of Papers."

(3) Article III, Section 5, eliminate the last sentence of the second paragraph, which reads:

"The Executive Committee is empowered to appoint a Treasurer *pro tem.* who shall be authorized to perform the duties of the Treasurer in case of his absence or disability."

and substitute a new paragraph, as follows:

"The Board of Direction may appoint an Assistant Treasurer who, in the absence or disability of the Treasurer, shall act in his stead."

U. S. Air Mail Service:

The following resolution was adopted regarding the expansion of the Air Mail Service and commercial flying:

"The Board of Direction of the American Society of Civil Engineers assembled in regular meeting on this date at New York hereby expresses its approval of expansion of the U. S. Air Mail Service and of commercial flying

generally, and particularly extends this expression of its approval to the committees of Congress now considering these subjects."

Model Act for Registration of Engineers:

On the recommendation of the Committee on Registration of Engineers, a Form of Act to be used as a model when such legislation is before State Legislatures, was adopted by the Board.* The Secretary was authorized to preprint the draft of the Act and to forward copies, together with a statement of the action of the Board, to the other Founder Societies, the American Engineering Council, the American Association of Engineers, the Western Society of Engineers, to other State and Local Societies, to all State Registration Boards, to the Local Sections, and to the Technical Press.

Meeting of the Incoming Board, January 22, 1925

The meeting of the incoming Board of Direction was held at Society Headquarters on January 22, 1925, the following being in attendance: President Robert Ridgway; Secretary George T. Seabury; and, also, Messrs. Brown, Chevalier, Condron, Dewell, Farnham, Fenkell, Gilman, Grunsky, Holmes, Howe, Humphrey, Ketchum, Loweth, Mason, Merriman, Norcross, Paul, Spofford, Webster, Whitman, and Treasurer Hovey.

Death of Roger M. Freeman, M. Am. Soc. C. E.:

The sudden death of Roger M. Freeman, M. Am. Soc. C. E., the son of Past-President, John R. Freeman, on January 22, 1925, was reported, and the following resolution was unanimously adopted:

"The members of the Board of Direction have learned of the great bereavement that has come to you in the passing away of your son, Roger M. Freeman, and extend to you and to Mrs. Freeman, and also to Mrs. Roger Freeman, their most sincere sympathy in this your great sorrow."

Budget for 1925:

The following budget for 1925 was adopted:

Income

	Item.	Estimated income for 1925.	
1	Entrance Fees	$16 000.00	
2	Dues	215 000.00	
3	Sale of Publications	4 500.00	
4	Binding of *Transactions*	8 000.00	
5	Sale of Badges	4 425.00	
6	Sale of Certificates	780.00	
7	Annual Meeting	4 000.00	
8	Interest on Bank Balance	1 200.00	
9	Interest on Bonds	2 960.00	
10	Income from 57th Street Property	22 703.00	
11	Postage	150.00	
12	Miscellaneous	2 000.00	
			$281 718.00

* See Society Affairs, p. 75.

DISBURSEMENTS

Item.		Appropriations for 1925.	
13	Salaries of Officers	$16 100.00	
14	Retirement Allowances	7 500.00	
15	Clerical Help	58 000.00	
16	Cost of Publications	68 000.00	
17	Binding of *Transactions*	6 000.00	
18	General Printing	4 500.00	
19	Badges	3 000.00	
20	Certificates of Membership	500.00	
21	Annual Prizes	355.00	
	Meetings:		
22	Annual Meeting	7 825.00	
23	Annual Convention (Cincinnati, 1925)	1 500.00	
23*a*	Annual Convention (Pasadena, 1924)	468.76	
24	Annual Summer Meeting (Salt Lake City, 1925)	1 500.00	
25	Annual Fall Meeting (Montreal, 1925)	1 500.00	
26	Monthly Meetings	1 100.00	
27	Local Sections	7 688.00	
	Technical Divisions:		
28	Sanitary	1 200.00	
29	Power	1 200.00	
30	Irrigation	600.00	
31	Highway	1 000.00	
32	City Planning	825.00	
33	Structural	500.00	
34	Waterway	300.00	
35	Traveling Allowance of Officers	17 000.00	
36	Traveling Allowance of Standing Committees	2 000.00	
37	Work of Committees	16 035.00	
38	Reading Room	500.00	
39	Employment Service	1 815.00	
40	Office Supplies	3 500.00	
41	Postage	12 000.00	
42	Furniture and Office Equipment	3 000.00	
43	Current Business	4 100.00	
44	United Engineering Society:		
	General Assessment (Rent)	6 450.00	
	Library	8 000.00	
	Telephone	1 200.00	
	John Fritz Medal Board	175.00	
45	Interest on Mortgage	9 000.00	
46	Premium on Insurance	535.00	
47	Miscellaneous	2 000.00	
			$278 471.76
	Unappropriated Balance		3 246.24
			$281 718.00

Special Committee to Consider Abuses in Bonding Practice:

The question of practices in bonding with respect to contracting work was discussed, and the following motion was passed, authorizing the appointment of a special committee to study the matter:

"Moved that the Board authorize the appointment of a special committee of the Society to consider the question of practices in the bonding business as

applied to engineering construction work and to confer and co-operate with similar committees from the American Institute of Architects, the Associated General Contractors, and other organizations interested in the subject, with a view to the presentation of joint recommendations to these several societies."

Columbia University Scholarship:

The following Report of the Committee on the Society's scholarship in the Columbia School of Mines, Engineering and Chemistry, was adopted:

"NEW YORK CITY,
"JANUARY 13TH, 1925.

"AMERICAN SOCIETY OF CIVIL ENGINEERS,
33 West 39th Street,
New York City.

"GENTLEMEN.—The following is the report of the Committee on the Scholarship of the Columbia School of Mines, Engineering and Chemistry.

"'Columbia has made available to the Society for the last three college years this graduate engineering scholarship amounting to $350, or substantially the tuition. During these three years only one application has been received and that was later withdrawn.

"'However, your Committee feels that effort should be made at least for one more year to secure a suitable candidate for the scholarship, and it accordingly repeats the recommendations of last year.

"'*1st.*—That in the spring appropriate notice again be given in the *Proceedings.*

"'*2nd.*—That a special notice be sent to each Local Section requesting that effort be made to secure suitable candidates.

"'*3rd.*—That the New York Local Section, in view of a probably greater local interest in a New York scholarship, be urged to make especial effort in the matter.

and adds,

"'*4th.*—That a special notice be sent to each Student Chapter.

"Respectfully submitted,

"ROBERT RIDGWAY,
"*Chairman.*"

Meeting of the City Planning Division

The Annual Meeting of the City Planning Division was held January 22, 1925, during the week of the Annual Meeting of the Society at the Engineering Societies Building, New York, N. Y., the Chairman, Edwin A. Fisher, M. Am. Soc. C. E., presiding. The election of the members of the new Executive Committee of the Division was announced as follows: Messrs. Charles B. Ball, Harland Bartholomew, Frederic H. Fay, Edwin A. Fisher, and Morris Knowles. It was decided that the Division as such would not participate in the International City Planning Conference to be held in New York in April, 1925, but that individual members ought to interest themselves in the proceedings and exhibitions. At the morning session a paper on "Scope of City Planning" was presented by Allen J. Saville, M. Am. Soc. C. E., and discussed by Messrs. George H. Norton, Frederic H. Fay, T. H. Skinner, W. G. Atwater, Arthur L. Vedder, Frank B. Williams, and John Ihlder. Resuming the meeting after lunch, Frank B. Williams, Esq., spoke on "The Present Status of Excess Condemnation." Immediately following, Arthur L. Vedder, Assoc. M. Am. Soc. C. E., delivered a paper on "The Use of Excess Condemnation

in the Opening, Widening, and Extension of Streets", followed by Charles W. Leavitt, M. Am. Soc. C. E., with a paper on "The Need and Scope of Excess Condemnation", and Frederic H. Fay, M. Am. Soc. C. E., on "Excess Condemnation in Massachusetts." The discussion on Excess Condemnation was opened by Horace H. Sears, M. Am. Soc. C. E., followed by Messrs. Frank O. Whitney, L. Durham, and W. H. Crawford.

Highway Division Holds Meeting

Both morning and afternoon sessions of the Highway Division were held in Engineering Societies Building, New York, N. Y., January 22, 1925. During these meetings resolutions were adopted bearing on contract bonds, the International Association of Road Congresses, and the Department of Public Works, as follows:

"Resolved, That the Board of Direction be and is hereby requested to appoint a Committee to co-operate with similar committees of the American Institute of Architects, The Associated General Contractors, and the American Association of State Highway Officials in endeavoring to find some solution for existing abuses in the writing of contract bonds."

"Be It Resolved, that the Permanent International Association of Road Congresses should be joined by the United States of America;

"That such Governmental action as may be necessary to that end should be had as promptly as practicable in order that the United States may be properly represented at the Fifth International Congress to be held in Milan, Italy, in September, 1926."

"Whereas, There is a Bill in Congress providing for the reorganization of the government departments, which in its present form proposes to substitute a subordinate division of Public Works within an existing department, for the Department of Public Works endorsed by the Board of Direction of this Society, which proposed division will belittle the position of the engineer in public service rather than give him the recognition he deserves and which was contemplated in the plan for a Department of Public Works; and,

"Whereas, Since the proposed transfer of the Bureau of Public Roads of the Department of Agriculture to a subordinate position in the proposed division of Public Works, and consequent division of its present functions, cannot fail to interfere with the successful co-operative relations with all State Highway Departments and the continuation of its extensive research work, thus bringing about a condition which highway engineers would deplore; now

"Therefore, Be It Resolved that the Highway Division affirms the stand of the Board of Direction for a Department of Public Works and respectfully petitions the Board of Direction to oppose the proposed scheme of reorganization as far as it relates to the engineering agencies of the government and particularly to oppose the transfer of the Bureau of Public Roads from the Department of Agriculture until a real executive Department of Public Works is provided for."

At its business session the meeting heard the report* of the Division for 1924 and expressed its opinion that the papers presented at the meeting should be printed in *Proceedings.* These papers and discussions were as follows: "Elements Governing the Development of Highway Traffic," by A. N. Johnson, M. Am. Soc. C. E., discussed by Messrs. W. H. Connell, Thomas R. Agg, Arthur W. Dean, and Van Alen Harris; "Recent Development in Highway Research," by Charles M. Upham, M. Am. Soc. C. E., discussed by

* See Society Affairs, p. 104.

Messrs. C. N. Conner and Prevost Hubbard; and "The Effect of Moisture on Concrete," by W. K. Hatt, M. Am. Soc. C. E., discussed by A. T. Goldbeck, Assoc. M. Am. Soc. C. E.

Power Division Meeting

At the time of the Annual Meeting of the Society a session of the Power Division was held on Thursday morning, January 22, 1925, at the Engineering Societies Building, N. C. Grover, Chairman, presiding. The Annual Report* of the Division for 1924 was presented, and the new members of the Executive Committee for 1925 were announced, as follows: Messrs. Daniel W. Mead, Arthur P. Davis, William W. Tefft, Charles Rufus Harte, and Nathan A. Carle.

The technical discussion was a Symposium on "High Specific Speed Hydraulic Turbines." Papers were presented by Messrs. George A. Orrok, Lewis F. Moody, Forrest Nagler, George A. Jessop, Charles C. Egbert, and John P. Hogan. Most of these papers were illustrated by lantern slides. Then followed a lively discussion of the subject in which the following participated: Messrs. Edward P. Hamilton, C. M. Allen, W. M. White, H. K. Bellows, George A. Orrok, H. F. Dunham, and P. A. Shaw. The interest in this up-to-date topic kept the meeting in session well beyond the customary lunch hour.

Sanitary Engineering Division Meeting

Both morning and afternoon sessions of the Sanitary Engineering Division of the Society were held at the Hotel Pennsylvania, New York, N. Y., on Thursday, January 22, 1925, with Harrison P. Eddy, M. Am. Soc. C. E., presiding officer.

At the Business Meeting held during the morning session, the Annual Report† of the Division was read and approved, a report‡ on the International Conference of Sanitary Engineers in London, England, in July, 1924, was submitted by T. Chalkley Hatton, M. Am. Soc. C. E., after which the meeting decided to appoint a committee to provide ways and means for holding a Conference in the United States in 1926, under the auspices of the Society and the Division. Reports were also received from a Committee on Definitions‖ and a Committee appointed to Report on the Work of the New Jersey Sewage Experiment Station.§ A paper by Irving I. Goldsmith, Esq., on "Laws Relating to Obnoxious Odors", and one by Stephen DeM. Gage, Esq., entitled "Methods of Determining Source and Extent of Obnoxious Odors", were presented and discussed.

Following a joint luncheon with the New York Section of the American Water Works Association, W. W. Horner, M. Am. Soc. C. E., spoke on co-ordinating the work of the Divisions of the various Technical Societies.

The newly elected Executive Committee of the Division was announced as follows: Messrs. Harrison P. Eddy, Charles H. Hurd, John C. McVea, Langdon Pearse, and W. L. Stevenson.

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* See Society Affairs, p. 107.
† See Society Affairs, p. 109.
‡ See Society Affairs, p. 113.
‖ See Society Affairs, p. 114.
§ See Society Affairs, p. 122.

The report of the Committee on the Rudolph Hering Medal was presented. Discussions of Mr. Gage's paper during the morning and afternoon sessions were made by Messrs. C. A. Holmquist, George H. Shaw, and L. L. Tribus. After Samuel A. Greeley, M. Am. Soc. C. E., had presented his paper on "Elimination of Odors from Garbage Disposal Plants" (discussed by Messrs. John V. Lewis and I. S. Osborn), John F. Skinner, M. Am. Soc. C. E., presented a paper on "Control of Odors from Sewage Treatment Plants", on which Messrs. T. Chalkley Hatton, C. E. Keefer, C. G. Gillespie, and Morris M. Cohn offered discussions. The final paper of the session was by Robert Spurr Weston, M. Am. Soc. C. E., entitled "The Detection and Elimination of Odors from Oil Refineries", which was discussed by Dr. N. E. Loomis, and Messrs. Edward Wright, T. Chalkley Hatton, and J. P. A. Maignen.

Structural Division Formed

At an all-day meeting in Engineering Societies Building, New York, N. Y., on January 22, 1925, the new Structural Division of the Society was organized. C. T. Bishop, M. Am. Soc. C. E., served as Temporary Chairman of the meeting. A Constitution for the Division was discussed and adopted.

After the report of the Nominating Committee, the following were elected as an Executive Committee: Messrs. H. C. Baird,* C. T. Bishop, Clement E. Chase, William G. Grove, and Charles F. Loweth. Various items with respect to the appointment of committees, the plan and scope of the work of the Structural Division, etc., were discussed. A resolution of thanks was voted the American Institute of Steel Construction for its courtesy in presenting copies of a booklet entitled "Steel Construction".

February Society Meeting

A regular meeting of the Society was held on February 4, 1925, at 8:00 P. M., in the Engineering Societies Building, New York, N. Y., President Robert Ridgway presiding. The minutes of the Fall Meeting at Detroit, Mich., October 22-25, 1924, and of the Society Meeting of November 5 and December 10, 1924, were approved as printed in *Proceedings* for December, 1924, and January, 1925, respectively. Following the reading of announcements by Secretary Seabury, the entire evening was devoted to the presentation of a paper by Charles S. Whitney, M. Am. Soc. C. E., entitled "Design of Symmetrical Concrete Arches". Using lantern slides and the blackboard, Mr. Whitney explained the general development of his theory, the assumption as to loading for a spandrel filled arch, the equation for the arch axis to agree with actual conditions, and the formula for the variation of rib thickness. Mr. Whitney explained how his studies had led to the development of diagrams for solving the complicated equation in practice (as given in the November, 1924, *Proceedings*), and the methods of using them, together with some of the significant deductions from these curves. In concluding the meeting, President Ridgway thanked Mr. Whitney for coming to New York to present his admirable paper. The attendance was about 60.

* Mr. Baird has resigned as a member of the Executive Committee.

Report of Tellers on Ballot for Officers of the Society

The following is the report of the Tellers appointed to canvass the ballot for officers of the Society as presented to the Annual Meeting, January 21, 1925:

"33 West 39th Street, New York, N. Y.
January 21, 1925

"To the Seventy-Second Annual Meeting
American Society of Civil Engineers:

"The Tellers appointed to canvass the Ballot for Officers of the Society for 1925 report as follows:

"Total number of ballots received	3 248
"Deduct	
Ballots from members in arrears of dues	17
" from non-corporate members	1
" unsigned	20
" with printed signatures	0
" with indecipherable signatures	0
" from members who have died since voting	2
"Total number not entitled to vote	40
"Ballots canvassed	3 208
Void ballots	3
Ballots counted	3 205
"For President:	
Robert Ridgway	3 198
Scattering	5
"For Vice-Presidents:	
Zone 2.—Richard Lewis Humphrey	2 929
Scattering	52
Zone 3.—Milo Smith Ketchum	3 059
Scattering	3
"For Directors:	
District No. 1 Willard Townshend Chevalier	3 023
Charles Gilman	3 027
Scattering	10
District No. 2 Charles Milton Spofford	3 014
Scattering	5
District No. 6 Albert Reesor Raymer	3 015
Scattering	2
District No. 10 Paul Howes Norcross	3 010
Scattering	2
District No. 13 Henry Dievendorf Dewell	3 025
Scattering	3

"Miles I. Killmer,
Charles S. Gleim,
F. A. Snyder,
R. Smillie,
Alger C. Gildersleeve,
Homer G. Balcom
Ernest B. Day,
Orrin L. Brodie,

"W. F. Reeves, *Chairman,*
R. Spiers Saunders,
Shortridge Hardesty,
E. R. Needles,
Albert W. Buel,
W. J. Boucher,
J. B. Snow,
H. D. Winsor,
Thos. H. Wiggin,
"Tellers."

Prize in Memory of John H. Dunlap

The late John H. Dunlap, Secretary of the Society, needs no monument to endear him to his fellow engineers, yet there is deep satisfaction in the recent action of the Iowa Engineering Society at its meeting in Des Moines, Iowa, on January 29, 1925, whereby it determined to make an annual award in memory of Mr. Dunlap to the Iowa engineer whose work has been most meritorious in the field of engineering during the preceding year. This action is doubly significant; it associates each prize winner with the name of one whose work and character stand pre-eminent among Engineers, and it gives John H. Dunlap a more tangible place in the State and the Society to which he gave his utmost. To be worthy of this award Iowa engineers must indeed aim high.

Minutes of Meeting of Executive Committee of the Highway Division

The new Executive Committee of the Highway Division, met in Washington, D. C., on January 23, 1925, and organized for the ensuing year by electing T. R. Agg, M. Am. Soc. C. E., as Chairman and C. D. Curtiss, M. Am. Soc. C. E., as Secretary. It was decided not to hold a meeting of the Division at the Annual Convention in Cincinnati, Ohio, April 22-24, 1925, but rather at the Summer Meeting in Salt Lake City, Utah, July 8-11, 1925. Decision as to sessions during the Fall Meeting in Montreal, Que., Canada, was deferred. A request to the Board of Direction to authorize a budget of $750 for the Division during the year 1925 was voted.

Sanitary Engineers' Dinner

The Sanitary Engineering Division held its customary dinner at the Hotel McAlpin, New York, N. Y., on the evening preceding the Annual Meeting of the Society, January 20, 1925, at 7.00 P. M.

In his introductory remarks Harrison P. Eddy, M. Am. Soc. C. E., Chairman, paid tribute to the memory of the late fellow member, George Chandler Whipple, M. Am. Soc. C. E. Professor C.-E. A. Winslow delivered the address of the evening on "The Atmosphere and Its Relation to Human Health and Comfort"—a comprehensive review of this broad subject—pointing out the fallacy of former theories as to disease transmission and ventilation and the results of recent research in these subjects. This was followed by a discussion of George A. Soper, M. Am. Soc. C. E., who laid stress on the insidious character of carbon monoxide as a poison and the danger incurred by its production with the increasing use of gas and gasoline for heat and power. There were 45 present at the dinner, including several guests.

Temple Bill for Topographic Mapping Merits Support

The situation with relation to Government mapping agencies was brought to the attention of members a year ago, when a condensed review of conditions appeared in the January, 1924, *Proceedings*, and the text of the Temple Bill

to correct matters, in the succeeding number, February, 1924. In brief, the present policy of spasmodic surveying activity on a hit-or-miss plan does not promise to complete the mapping of the remaining half of the United States for an indefinite time; under the terms of the Temple Bill it will be accomplished within twenty years. The attitude of engineers toward these matters is well expressed by J. K. Finch, Assoc. M. Am. Soc. C. E., the Society's representative on the Advisory Council re Co-ordination of Federal Map Making Efforts, whose official report for the year 1924 states in part as follows:

"1. Engineers in general, including members of the American Society of Civil Engineers, were heartily in favor of co-ordinating the map making work of the Federal bureaus through the establishment of the Board of Surveys and Maps (instituted in 1919), thus bringing about a better understanding between the bureaus and avoiding duplication of effort.

"2. The Engineering Profession values the work of the U. S. Coast and Geodetic Survey, or the U. S. Geological Survey, and believes that the maps published by them meet general needs, and engineering needs in particular, as fully as any practical form that can be issued.

"3. It is not to be expected that the Federal agencies can issue maps of such precision or refinement as to serve for detailed engineering studies; however, their maps are of great engineering value for reconnaissance and preliminary study and their geological sections are very useful.

"4. Engineers are interested in the passage of the Temple Bill providing for the systematic completion of the mapping of the United States, not merely because they recognize the great value of the maps to the profession, but especially because they are convinced that only by systematic expenditures with necessary funds available each year can such work be carried on effectively and economically. Also they realize that from the standpoint of National defense these maps are indispensable."

For three years this question has been under consideration of Congress. Many engineers have appeared and advocated its passage; technical societies have acted favorably in urging it; the Board of Direction of the Society has officially recognized its importance and voted support. It remains for individual members—the most effective factors—to exert their great influence by keeping in touch with their legislative representatives, and urging the advisable passage of the Temple Bill. The general public may not realize the value of mapping; it therefore behooves engineers the more to correct the present unfortunate situation.

John F. Stevens Awarded John Fritz Gold Medal

The twenty-first award of the John Fritz Gold Medal was made January 16, 1925, to John Frank Stevens, Hon. M. Am. Soc. C. E., of New York, N. Y., for great achievements as a Civil Engineer, particularly in planning and organizing for the construction of the Panama Canal; as a builder of railroads; and as administrator of the Chinese Eastern Railway.

This Medal was established in 1902 in honor of John Fritz, one of the great pioneers in the American iron and steel industry. It is awarded annually for notable scientific or industrial achievement and is the highest honor bestowed by the Engineering Profession in the United States.

The award was made by a board of sixteen representatives of the American Societies of Civil, Mining and Metallurgical, Mechanical, and Electrical Engineers, having a total membership of 53 000.

John F. Stevens is one of the most widely known and highly esteemed American civil engineers. He was born at West Gardiner, Me., April 25, 1853, and while still a young man went to the Middle West, where he was active in railroad engineering for many years.

At various times in early life, he was Chief Engineer, Vice-President, or Manager, of the Great Northern Railway, Chicago, Rock Island, and Pacific Railway, New York, New Haven and Hartford Railroad, and President, successively, of the Spokane, Portland and Seattle Railway, the Oregon Electric Railway, and other Western railroads.

Mr. Stevens was Chief Engineer of the Panama Canal from 1905 to 1907 and in 1907 acted as Director of the Isthmian Canal Commission. His masterful organization of the personnel of the Canal forces, and especially of the transportation system, contributed mightily to the effective construction work on the Canal under his successor, Maj.-Gen. George W. Goethals, U. S. A. (*Retired*), M. Am. Soc. C. E.

Mr. Stevens, as head of the American Railway Mission to Russia, 1917-18, rendered heroic service toward the success of the allied nations in the World War. He was also Director of a corps of railway experts in Manchuria. From 1919 to 1923, he was President of the Inter-Allied Technical Board supervising the Siberian Railways, bringing a notable measure of order into the chaos of the Siberian railway situation. While holding this office, with headquarters at Harbin, Manchuria, he supervised the technical and economic operation of the Siberian and Chinese Eastern Railway. Mr. Stevens was elected an Honorary Member of the Society on June 19, 1922.

The John Fritz Gold Medal has heretofore been awarded to the following distinguished engineers:

John Fritz	James Douglas
Lord Kelvin	Elihu Thomson
George Westinghouse	Henry Marion Howe
Alexander Graham Bell	J. Waldo Smith
Thomas Alva Edison	George W. Goethals
Charles T. Porter	Orville Wright
Alfred Noble	Sir Robert A. Hadfield
Sir William Henry White	Charles Prosper Eugene Schneider
Robert W. Hunt	Senator Guglielmo Marconi
John Edson Sweet	Ambrose Swasey

Society Representatives

Members have been appointed to act for the Society in various capacities as follows:

Advisory Committee on Civil Engineering of the Division of Engineering of the National Research Council, Frank A. Barbour, M. Am. Soc. C. E. (succeeds Robert A. Cummings, M. Am. Soc. C. E., resigned).

Advisory Committee on Cement of the U. S. Department of Commerce, Thaddeus Merriman, M. Am. Soc. C. E.

Joint Committee with the American Association for the Advancement of Science, the American Institute of Electrical Engineers, the American Society of Mechanical Engineers, and the Society for the Promotion of Engineering Education, to act as a "Steering Committee" to initiate a study of "Engineering Abbreviations and Symbols", Charles M. Spofford, M. Am. Soc. C. E.

Special Committee on Cement (new Society Committee), Thaddeus Merriman, M. Am. Soc. C. E., Chairman, A. N. Talbot, Past-President Am. Soc. C. E., and John R. Baylis, Assoc. M. Am. Soc. C. E.

Special Committee on Engineering Contract Bonding (new Society Committee), H. G. Shirley, Chairman, J. S. Langthorn, and Frank C. Wight, Members, Am. Soc. C. E.

Conference with War Department on Construction Industry, Washington, D. C., January 16, 1925, Francis Blossom, Roger M. Freeman,* Francis Lee Stuart, Milo S. Ketchum, and W. J. Wilgus, Members, Am. Soc. C. E.

Financial Report of United Engineering Society

The United Engineering Society is in charge of the Engineering Societies Building, of the Engineering Societies Library, of the John Fritz Medal, and of other similar engineering interests. From its financial statement for the year 1924 is taken the following summary, which may prove of interest to members:

Operation of Building

Credit balance January 1, 1924		$8 070.94
Revenue from prior years		50.00
Building revenue, 1924	$114 932.65	
Building expenditures, 1924	97 248.95	17 683.70
		$25 804.64
Annual payment to Depreciation and Renewal Fund	$12 000.00	
Additional Payment to Depreciation and Renewal Fund	5 000.00	
Reserve for depreciation of capital of Engineering Societies Library	4 000.00	21 000.00
Credit balance December 31, 1924		$4 804.64

Operation of Library

Maintenance and Recataloging revenue	$39 853.48	
Maintenance and Recataloging expenditures	39 853.48	
Balance December 31, 1924		$0.00
Service Bureau revenue	$19 363.26	
Service Bureau expenditures	18 828.95	
Operating balance		$534.31
Previous credit balance		863.81
Credit balance December 31, 1924		$1 398.12

* Died January 22, 1925.

Funds and Property

Funds held by United Engineering Society, December 31, 1924 (Book Value):	
Depreciation and Renewal	$175 269.29
Engineering Foundation	477 720.05
Library Endowment	96 047.00
General Reserve	10 000.00
John Fritz Medal (United Engineering Society, Custodian)	3 500.00
Reserve for Depreciation of Capital of Library	4 000.00
Total	$766 536.34
Real Estate owned by United Engineering Society, cost to Dec. 31, 1924	1 966 569.44
Operating cash and petty cash	10 504.59
Accounts receivable	2 141.97
Value of Library (as appraised for insurance)	329 000.00
Total property for which United Engineering Society is Trustee or Custodian	$3 074 752.34

Relation of Engineering Colleges and Engineering Societies

One phase of the studies now being undertaken by the Board of Investigation and Co-Ordination of the Society for the Promotion of Engineering Education, concerns the effects of engineering colleges and engineering societies the one on the other. Specifically, the studies hope to determine (1) "what distinguishes a profession from a business, a trade, or any other form of vocation"; (2) the relations of professional organizations in other fields than engineering with the corresponding groups of professional schools; and (3) the situation as effecting schools and societies in Europe (being studied by W. E. Wickenden, Director of the Board, during 1925). Comments of individual members on any of these questions are invited. Address the Society for the Promotion of Engineering Education, 33 West 39th Street, New York, N. Y.

Beware of "Denny" or "Denning"

Beware of a bogus engineer styling himself "R. L. Denny" or "R. L. Denning". He is described as about 30 years of age; weight, 160; height, 5 ft. 6 in., and medium to dark color, of intelligent and convincing speech. He may claim to be a Cornell man, a member of Psi Upsilon fraternity, or a member of the Society, as best suits his immediate purpose, which usually has been to obtain loans or to cash worthless checks. He has used a fraternity pin and a Society badge, neither of them his own. He has a jail record for activities in Brooklyn, N. Y., and elsewhere in 1921. Since this experience he has left the unfriendly atmosphere of the Atlantic Coast and has lately been plying his trade in California with great profit according to a report from the Better Business Bureau of Fresno.

Annual Convention of the American Mining Congress

"To bring mining back" was the goal of the Twenty-seventh Convention of the American Mining Congress. The sessions were held September 29 to

October 4, 1924, at Sacramento, Calif., where Leonard M. Cox, M. Am. Soc. C. E., and Edward Hyatt, Jr., Assoc. M. Am. Soc. C. E., represented the Society.

During the past five years there has been a great diminution in mining, refining, and smelting activity, estimated by the Secretary of the Congress to be 60 per cent. The economic aspect of the industry accordingly received the most emphasis at this session, and the following eight topics were treated: (1) Federal Taxation; (2) Financing Mining; (3) Stabilizing the Mining Industry; (4) Tariff on Minerals; (5) Government Paternalism in Industry; (6) Industrial Relations; (7) Problems of the Gold; and (8) Standardization. A protest was entered against the unequal taxation of "par value" and "no par value" stock, and against taxing stock dividends as income of the earning corporation rather than of individual owners. Detailed consideration was given the fixed price of gold and the increasing cost of production in their effect on gold mining. A number of remedial legislative measures were suggested. Papers on the production of petroleum created general interest, particularly those describing the production of fuel oil from shale. The Convention was noteworthy as a gathering of operators and business men who sought definite and constructive action. The delegates of the Society expressed their enjoyment of the hospitality of Sacramento and of a unique staging of "Placer Mining in '49".

Convention of Minnesota Engineers and Architects

Engineering and Allied Societies of the State of Minnesota met at Minneapolis, in a series of meetings for three days, January 22-24, 1925. The Thirtieth Annual Convention of the Minnesota Surveyors and Engineers Society was held on January 22, at which after a short Business Meeting the various Sections of the Society held simultaneous meetings, including Highway, Municipal, Drainage, and Surveying Sections with detailed and comprehensive programs. On January 23 and 24 following, the Annual Convention of the Minnesota Federation of Architectural and Engineering Societies (a larger inclusive organization), was held. In addition to the business of the meeting, important addresses were delivered by State officials and engineers, educators, Army officers, lawyers, and industrial leaders. Affiliated with the Minnesota Federation is the Northwestern Section of the Society. This Convention is an example of the possibilities of co-operation among Engineering Societies included within a State.

Local Sections*

Central Ohio.—January 13, 1925. Annual Meeting. Director Charles H. Paul gave an interesting talk on the work of the Board of Direction and of the Society in general. The licensing of engineers and the duties of Local Sections was also discussed. Thirty members of the Ohio State University Student Chapter attended the meeting. Attendance 47.

Cleveland.—January 14, 1925. After a business meeting the following officers were elected: President, George H. Tinker; Vice-President, J. E. A. Linders; Secretary-Treasurer, A. G. Husted. Attendance 15.

Connecticut.—January 10, 1925. A luncheon meeting was held at Hartford, Conn., at which Secretary George T. Seabury, Retiring Director Frank E. Winsor, and Incoming Director Charles M. Spofford were present. The principal topic of discussion was the functions of the Local Membership Committees. Attendance 23.

Dayton.—January 12, 1925. An interesting lecture illustrated with slides was given by William Neifert, Meteorologist of the U. S. Weather Bureau at Dayton. Attendance 28.

Detroit.—January 9, 1925. This was a joint meeting of the Section with the Detroit Engineering Society to discuss the subject of "The Relation of the Chicago Drainage Canal to the Great Lakes Waterway Project". The history of the Canal and the work of the Engineering Board of Review in this connection were discussed. The speakers were united in a plea for regulation of lake levels by controlling works as an essential factor for the development of the commerce of the Great Lakes. Attendance 150.

District of Columbia.—January 17, 1925. Annual Meeting. The following officers were elected: President, James H. Van Wagenen; Vice-President, David J. Howell; Secretary-Treasurer, C. Dwight Avery. After the business meeting, addresses were given by Maj.-Gen. William M. Black, U. S. A. (*Retired*), on "The Engineer in Public Service", and by the Hon. Elwood Mead, Commissioner, U. S. Bureau of Reclamation, M. Am. Soc. C. E., on "New Problems of Irrigation Reclamation". Attendance 66.

Duluth.—November 17, 1924. A. B. Horwitz, Zoning Engineer for the Duluth City Planning Commission, gave a detailed and interesting talk on the proposed Zoning Ordinance for the City of Duluth with particular relation to the question of the health, safety, morals, and general welfare of the community. A brief discussion followed. Attendance 18.

December 15, 1924. George Stevens, Patent Attorney and Naturalist, gave an instructive address which was illustrated with lantern slides, on experiences in taming birds, squirrels, chipmunks, and other wild creatures. Harland Bartholomew, Engineer of the City Planning Commission of St. Louis, delivered an informal address on the activities of the St. Louis Engineers with relation to large public bond issues, smoke inspection, planning of a

* For list of Local Sections, Officers, Rules, etc., see 1924 Year Book, p. 27.

municipal center, and public employment of architects and engineers in the work of supervision. Attendance 24.

Georgia.—January 12, 1925. After passing resolutions relative to city planning and traffic conditions at Atlanta, the following officers were elected: President, Frederick H. McDonald; Vice-Presidents, Nisbet Wingfield and S. R. Young; Secretary-Treasurer, Clyde M. Wood. Attendance 17.

Kansas.—December 11, 1924. Annual Meeting. The following officers were elected: President, Lloyd B. Smith; Vice-President, W. V. Buck. An interesting talk was given by L. W. Wallace, Secretary of the American Engineering Council. Attendance 32.

Kansas City (Mo.).—January 8, 1925. Annual Meeting. The following officers were elected: President, Howard P. Treadway; Vice-President, Ernest E. Howard; Secretary-Treasurer, E. C. L. Wagner. Mr. G. H. Clay addressed the Section on "The Undeveloped Chemical Industries of Kansas City". Attendance 34.

Los Angeles.—September 17, 1924. President Thomas gave a talk on the history of the Section in celebration of the One Hundredth Meeting. Addresses were also given by Maj. Charles T. Leeds, U. S. A. (*Retired*), and Maj.-Gen. Lansing H. Beach, U. S. A. (*Retired*). Professor B. R. Baumgardt, of the National Geographic Society, spoke on "The Dawn of Civilization in the Valley of the Nile". Many beautiful stereopticon views were shown. Attendance 153.

October 8, 1924. R. B. Hill, Superintendent of Operations of the Los Angeles Railway Company, presented a paper entitled "Bus Transportation", in which he outlined the history of the omnibus. The subject was further augmented by Mr. Frank Farnham, in charge of the motor-bus transportation of the Pacific Electric Railway Company, who spoke of the motor bus as an adjunct to railroad transportation. A general discussion of the subject followed. Attendance 52.

November 12, 1924. Mr. Franklin D. Howell gave an address on "Motor Bus Transportation", which was followed by discussion. Attendance 55.

December 10, 1924. Annual Meeting. The following officers were elected: President, S. B. Morris; Second Vice-President, H. A. Van Norman; and Treasurer, E. R. Bowen. Mr. A. L. Sonderegger presented a paper on "Local Water Supply of the Metropolitan Area of Los Angeles" which was illustrated with numerous charts and pictures and dealt specifically with the geology of the district surface, and ground-water conditions and cyclic storage. Interesting discussion followed. Attendance 112.

January 14, 1925. Mr. Edwin Bergstrom, President of the Allied Architects Association, spoke on "The Administration Center Plan for the City of Los Angeles". Mr. Bergstrom was followed by Mr. Sumner P. Hunt, who spoke on the same subject. Discussion followed. Attendance 66.

Milwaukee.—December 17, 1924. Annual Meeting. The following officers were elected: President, T. Chalkley Hatton; First Vice-President, Will J.

Sando; Second Vice-President, C. R. Weymouth; Secretary-Treasurer, H. Erskine Nicol.

New York.—January 14, 1925. The Section participated with the Local Section of the American Institute of Electrical Engineers and the New York Electrical Society in a joint meeting on Electrical Research. Dr. W. R. Whitney, Director of the Research Laboratory of the General Electric Company, spoke on "Electricity and Matter in Five Minutes". Dr. W. P. Davey, of the Experimental Staff of the General Electric Company Research Laboratory, gave an illustrated talk on "X-Rays and Their Uses". Attendance 675.

Sacramento.—November 25, 1924. Mr. Edward M. Ornitz, of Pittsburgh, Pa., gave an address on "The Control of Water in Concrete by the Inundation Method". Attendance 25.

December 2, 1924. At a joint luncheon of the Section and the Sacramento Chapter of the American Association of Engineers Mr. F. J. D'Andreis of the Division of Immigration and Housing of the State Department of Labor, described the work being done for immigrants in the State, especially in regard to contract labor. Attendance 37.

December 23, 1924. The regular weekly luncheon was followed by a Christmas celebration. Mr. Clay Chipman, of the California Highway Commission, and Professor B. A. Etcheverry, of the University of California, Berkeley, gave addresses on work done by members on survey parties and on the standardization of Christmas cards, respectively, which contributed to the merriment of the occasion. An open meeting of the Public Relations Committee of the Section was made a feature of the program. Attendance 30.

January 13, 1925. Annual Meeting. The following officers were elected: President, Joseph C. Boyd; First Vice-President, J. Burdette Brown; Second Vice-President, Everett N. Bryan; Secretary, Norwood Silsbee. Attendance 21.

January 17, 1925. The retiring President, Mr. C. S. Pope, delivered an address on "The Engineer's Place in History" and was followed by President Joseph C. Boyd, who gave a review of the progress made in engineering during the forty years he has practiced his profession in Sacramento. Addresses were also made by Messrs. Edward Hyatt, Jr., Albert Givan, and W. F. McClure. Attendance 60.

January 27, 1925. Action was taken to increase the annual dues to $2.50. The meeting was addressed by State Forester M. D. Pratt who spoke on "Reforestation". Attendance 28.

San Francisco.—January 15, 1925. Annual Meeting. After a dinner which was attended by 92 members and guests, the following officers were elected: President, H. C. Vensano; First Vice-President, B. A. Etcheverry; Second Vice-President, Nelson A. Eckart; Secretary-Treasurer *pro tem*, Henry D. Dewell. When the business of the Section had been transacted, Professor Charles Derleth, Jr., of the University of California, gave an address on the "Design and Construction of the Carquinez Highway Bridge", which was illustrated by lantern slides. The address was followed by discussion. Attendance 110.

FORM OF AN ACT OF LEGISLATION

FOR REGISTRATION OF PROFESSIONAL ENGINEERS

RECOMMENDED WHERE SUCH LEGISLATION IS PENDING

BY THE

BOARD OF DIRECTION

AMERICAN SOCIETY OF CIVIL ENGINEERS

JANUARY 20, 1925

FOREWORD

The Form of an Act of Legislation for Registration of Professional Engineers has been drafted after a careful study of the several laws of this kind that have been enacted by more than twenty of the States during recent years. The desirability of uniformity in such laws is self-evident and in the interests of the general public as well as of the Engineering Profession, this draft of an Act approved by the Board of Direction of the American Society of Civil Engineers, is recommended, where such legislation is under consideration by a Legislature at this time.

It is realized that the Constitutional requirements and the machinery of government vary in different States and therefore certain sections of this draft will need to be rewritten to conform to such special requirements. In general, it is believed that the fundamental features of this draft will meet the needs in all of the States where Registration of Engineers is deemed desirable and that the provisions of the Act as drafted will safeguard the best interests of all concerned.

AN ACT to regulate the practice of professional engineering; creating a State Registration Board for Professional Engineers; defining its powers and duties; also imposing certain duties upon the State and political subdivisions thereof in connection with public work; and providing penalties.

Section 1.—Be it enacted, by the General Assembly of the State of..... .....that in order to safeguard life, health and property, any person practicing or offering to practice professional engineering hereafter in this State shall be required to submit evidence that he or she is qualified so to practice, and shall be registered as hereinafter provided; and that it shall be unlawful, after the first day of.....one thousand nine hundred and.....for any person to practice or to offer to practice professional engineering in this State unless such person has been duly registered as a "professional engineer", or has been exempted from registration under the provisions of this Act.

Section 2.—Definitions.—The term "professional engineer", as used in this Act, means a person who through technical knowledge gained by education and/or by experience is qualified to practice one or more branches of professional engineering. The term "professional engineering", as used in this Act, means the investigation, planning, designing and supervising of projects and structures when the proper performance of such services requires technical or engineering knowledge.

Section 3.—State Registration Board for Professional Engineers.—Appointment of Members.—Terms.—A State Registration Board for Professional Engineers is hereby created. The Board shall consist of five registered professional engineers, who shall be appointed by the Governor and shall have the qualifications required by Section 5. The members of the first Board shall be appointed within ninety days after the passage of this Act, to serve for the following terms: One member for one year, one member for two years, one member for three years, one member for four years, and one member for five years, from the date of their appointment, or until their successors are duly appointed and qualified. On the expiration of the term of any member, the Governor shall appoint for a term of five years a registered professional engineer, having the qualifications required by Section 5, to take the place of the member whose term on said board is about to expire. Each member shall hold office until the expiration of the term for which such member is appointed or until a successor shall have been duly appointed and shall have qualified.

Section 4.—Removal of Members of Board.—Vacancies.—The Governor may remove any member of the Board for misconduct, incompetency, neglect of duty, or for any other sufficient cause. Vacancies in the membership of the Board shall be filled by appointment by the Governor for the unexpired term.

Section 5.—Qualifications of Members of Board.—Each member of the Board shall be a citizen of the United States and a resident of this State, and

NOTE.—It is suggested that this draft be submitted to the Legislative Reference Bureau or corresponding review authority to make it conform to the State Constitution prior to its introduction.

shall have been engaged in the practice of the profession of engineering for at least ten years, and shall have been in responsible charge of engineering work for at least five years.

Section 6.—Compensation and Expenses of Members of Board.—Each member of the Board shall receive the sum of twenty-five ($25) dollars per diem when actually attending to the work of the Board or of any of its committees and for the time spent in necessary travel; and in addition thereto, shall be reimbursed for all actual traveling, incidental, and clerical expenses necessarily incurred in carrying out the provisions of this Act.

Section 7.—Registration of First Board.—Certificate of Appointment.—Oaths of Members.—Legal Adviser.—Each member of the first Board shall receive, at the time of appointment, a certificate of registration as a "professional engineer" from the Governor of this State. Each member of the Board when appointed shall receive a certificate of appointment from the Governor, and, before entering upon the duties of the Board, shall take and subscribe to the oath required, which shall be filed with the Secretary of this State. The Attorney General of this State shall be the legal adviser to the Board.

Section 8.—Organization of Board.—Meetings.—Officers.—Quorum.—The Board first appointed shall hold a meeting within thirty days after its appointment, and shall organize by the election of one of its members as Chairman and annually thereafter shall elect from its members a chairman. The Board shall hold at least two meetings each year and such special meetings as may be provided for in its by-laws or as a majority of the members may desire. The Board shall appoint a Secretary, who shall hold office during its pleasure. A quorum of the Board shall consist of three members.

Section 9.—Power to Subpoena Witnesses.—Oaths.—In carrying into effect the provisions of this Act, the Board may, under the hand of its Chairman and the seal of the Board, subpoena witnesses and compel their attendance, and also may require the production of books, papers, documents, etc. Any member of the Board may administer oaths or affirmations to witnesses appearing before the Board. If any person shall refuse to obey any subpoena so issued, or shall refuse to testify or produce any books, papers, or documents, the Board may present its petition to the Court of ..... (insert name of Court) of the County in which it may be in session, setting forth the facts, and thereupon such Court shall, in a proper case, issue its subpoena to such person, requiring his or her attendance before such Court and there to testify or to produce such books, papers, and documents, as may be deemed necessary and pertinent by the Board. Any person failing or refusing to obey the subpoena or order of the said Court may be proceeded against in the same manner as for refusal to obey any other subpoena or order of the Court.

Section 10.—Seal of Board.—By-Laws and Rules.—The Board shall adopt and have an official seal. The Board shall have power to make all the by-laws and rules, not inconsistent with the Constitution and Laws of this State, which may be reasonably necessary for the proper performance of its duties and the regulations of the proceedings before it.

Section 11.—Office of Board.—Supplies.—Printing.—The..... shall furnish the Board with suitable quarters in the city of.....

and shall also furnish to said Board, upon requisition, all furniture, books, papers, supplies, facilities, equipment, etc., which may be necessary for the transaction of its business. All printing required by the Board shall be furnished by the State Printer, upon requisitions of the Chairman of the Board upon the.....

Section 12.—Engineers' Fund in State Treasury Established.—Appropriation.—Payments Therefrom.—Bond of Secretary.—Clerks and Assistants.—The Secretary of the Board shall receive and account for all moneys derived under the provisions of this Act, and shall pay the same monthly to the State Treasurer, who shall keep such moneys in a separate fund, to be known as the "Professional Engineers' Fund". Such fund shall be kept separate and apart from all other moneys in Treasury, and shall be paid out only by warrant of the State Auditor upon the State Treasurer, upon itemized vouchers approved by the Chairman and attested by the Secretary of the Board. All moneys in the "Professional Engineers' Fund" are hereby specifically appropriated for the use of the Board. The Secretary of the Board shall give a surety bond to this State in such sum as the Board may determine. The premium on said bond shall be regarded as a proper and necessary expense of the Board, and shall be paid out of the "Professional Engineers' Fund". The Secretary of the Board shall receive such salary as the Board shall determine. The Board may employ such clerical or other assistants as are necessary for the proper performance of its work.

Section 13.—Initiating Appropriation.—The sum of..... dollars is hereby appropriated from the general funds to inaugurate the work of this Board; the general funds to be reimbursed from the "Professional Engineers' Fund" as soon as that amount ($.....) may be available.

Section 14.—Register of Applications for Registration.—Contents.—The Board shall keep a record of its proceedings, and a register of all applications for registration, which register shall show: (*a*) the name, age, and residence of each applicant; (*b*) the date of the application; (*c*) the place of business of such applicant; (*d*) his educational and other qualifications; (*e*) whether or not an examination was required (*f*) whether the applicant was rejected; (*g*) whether a certificate of registration was granted; (*h*) the date of the action of the Board; and (*i*) such other information as may be deemed necessary by the Board.

Section 15.—Records of Board to Be Evidence.—The records of the Board shall be *prima facie* evidence of the proceedings of the Board set forth therein, and a transcript thereof, duly certified by the Secretary of the Board under his seal, shall be admissible in evidence with the same force and effect as if the original were produced.

Section 16.—Roster of Registered Professional Engineers.—A roster showing the names, places of business, and the residences of all registered professional engineers shall be prepared by the Secretary of the Board during the month of .....of each year commencing one year from the date this law becomes effective. Copies of this roster shall be obtainable by each person so registered, upon application to the Secretary of the Board. A copy

of this roster shall be placed on file by the clerk of each county, city, borough and town in this State.

Section 17.—Annual Report.—Annually, as of..... (insert date), the Board shall submit to the Governor a report of its transactions of the preceding year, and shall also transmit to him a complete statement of the receipts and expenditures of the Board, attested by affidavit of its Chairman and its Secretary.

Section 18.—Certificates of Registration.—Qualifications of Applicant.—The Board, upon application on the form prescribed by it, and upon the payment of a fee of.....dollars, and except as hereinafter provided, shall issue to any person who submits evidence, satisfactory to the Board, that he or she is qualified to practice professional engineering, a certificate of registration as a professional engineer.

Provided that no person, except as stated in Sections 19 and 20, shall be eligible for registration as a professional engineer who is not a citizen of the United States or of the Dominion of Canada and at least twenty-five years of age or who does not speak, read, or write, the English language, or who is not of good character and repute, or who has not been actively engaged for at least seven years in professional engineering work, which practical experiences are to be of a character satisfactory to the Board; however, each year of the study of engineering in a school or college satisfactory to the Board shall be considered as equivalent to one year of active practice, but the total number of years of study which may be credited to such seven years of active practice shall not exceed four years, and provided, further, that each year of teaching of engineering by a graduate engineer in an engineering school or college of recognized high standing satisfactory to the Board, shall be considered as equivalent to one year of active practice; but such teachers of engineering desiring to practice professional engineering shall submit satisfactory evidence of at least two years practical experience in professional engineering in addition to their teaching experience.

Section 19.—Citizens of Foreign Countries.—A citizen of a foreign country upon presentation of satisfactory evidence that he has practiced professional engineering for a period of more than seven years, and that he is qualified so to practice, may, at the discretion of the Board, be granted a certificate of registration as a professional engineer.

Section 20.—Persons Entitled to Registration.—Unless disqualifying evidence is submitted to the Board, the following facts, established in the application, shall be regarded as evidence satisfactory to the Board, that the applicant is qualified to practice, as a professional engineer, to wit:

(*a*) A specific record of seven or more years of active engagement in engineering work of a character satisfactory to the Board.

(*b*) Graduation from a school or college approved by the Board as of satisfactory standing, having a course in engineering of not less than four years, and a specific record of an additional three years of active engagement in engineering work, of a character satisfactory to the Board.

Section 21.—Furnishing of Additional Evidence by Applicants for Registration Examinations.—Applicants for registration, in cases where the evidence

presented in the applications does not appear to the Board conclusive nor warranting the issuing of a certificate of registration, may be required to present, for the consideration of the Board, further evidence, and may also be required to pass an oral or written examination, or both, as the Board may determine.

Section 22.—Majority of Board to Pass Upon Applications.—Return of Registration Fee.—A satisfactory character of the applicant shall be an essential, and a majority vote of the members of the Board shall be required to pass upon the qualifications of the applicant for registration as a professional engineer. Should the Board deny the issuance of a certificate of registration to the applicant, the registration fee deposited, less ten ($10) dollars, shall be returned to the applicant. The Board, after satisfactory examination or receiving other satisfactory evidence of qualification of the applicant, as provided in this Act, shall issue a certificate of registration authorizing the applicant to practice as a professional engineer. The Board shall impress upon each certificate of registration issued under this Act the seal of the Board.

Section 23.—Practice of Firms, Co-Partnerships, Corporations, and Joint Stock Associations.—A firm, or a co-partnership, or a corporation, or a joint stock association may engage in the practice of professional engineering in this State only provided such practice is carried on under the responsible direction of one or more registered professional engineers whose name or names and seal or seals shall appear on all plans and other official documents issued in connection with such professional engineering practice.

Section 24.—Persons Exempted from Registration.—The following persons shall be exempted from registration under the provisions of this Act, to wit:

(*a*) A person not a resident of, and having no established place of business in this State, offering to practice in this State as a professional engineer.

(*b*) A person not a resident of, and having no established place of business in this State, practicing as a professional engineer when such practice does not exceed in the aggregate more than sixty days in any calendar year; provided, that such person is legally qualified as a professional engineer in his or her own State or country.

(*c*) A person not a resident of, and having no established place of business in this State, or who has recently become a resident of this State, practicing therein for more than sixty days as a professional engineer: provided, however, that he or she shall have filed with the Board an application for registration as a professional engineer, and shall have paid the fee required by this Act. Such exemption shall continue only for such time as the Board may require for the consideration of the application for registration; and further provided, that such person is legally qualified as a professional engineer in his or her own State or country.

(*d*) An employee of a registered professional engineer who is engaged in the practice of professional engineering, and an employee of a professional engineer exempted from registration by Classes (*b*) and (*c*) of this Section; provided, that such practice does not include responsible charge of design or supervision.

Section 25.—Revocation of Registration.—Procedure.—The Board shall have the power to revoke the certificate of registration of any registrant, who is found guilty of:

(*a*) The practice of any fraud or deceit in obtaining a certificate of registration;

(*b*) Any gross negligence, incompetency, or misconduct in the practice of professional engineering as a registered professional engineer.

Any person may prefer charges of fraud, deceit, negligence, incompetency, or misconduct against any registrant. Such charges shall be in writing, and shall be sworn to by the person making them and shall be filed with the Secretary of the Board.

All charges, unless dismissed by the Board as unfounded or trivial, shall be heard and disposed of by the Board within three months after the date on which they shall have been preferred.

The time and place for said hearing shall be fixed by the Board, and a copy of the charges, together with a notice of the time and place of hearing, shall be personally served on or mailed to the last known address of such registrant, at least thirty days before the date fixed for the hearing. At any hearing, the accused registrant shall have the right to appear personally and by counsel, to cross-examine witnesses appearing against him or her, and to produce evidence and witnesses in his own or her own defense.

If, after such hearing, three or more members of the Board vote in favor of finding the accused guilty of either:

(*a*) The practice of fraud or deceit in obtaining a certificate or registration; or

(*b*) Any gross negligence, incompetency, or misconduct in the practice of professional engineering as a registered professional engineer;

the Board shall revoke the certificate of registration of such registered professional engineer.

The Board, for reasons it may deem sufficient, may re-issue a certificate of registration to any person whose certificate has been revoked, providing three or more members of the Board vote in favor of such re-issuance. A new certificate of registration, to replace any certificate revoked, lost, destroyed, or mutilated, may be issued, subject to the rules and regulations of the Board. A charge of ten ($10) dollars shall be made for such issuance.

Section 26.—Appeals to Court When Registration is Revoked.—Any registrant who shall feel aggrieved by any action of the Board in revoking a certificate of registration may appeal therefrom to the Court of..... (insert name of Court).....County, and, after full hearing, said Court shall make such decree either sustaining the action of the Board or reinstating the certificate of registration of such registrant, as it may seem just and proper.

Section 27.—Seal of Registered Professional Engineers.—The issuance of a certificate of registration by the Board shall be evidence that the person named therein is entitled to all the rights and privileges of a registered professional engineer, while the said certificate remains unrevoked or unexpired.

Each registrant hereunder shall, upon registration, obtain a seal of the design authorized by the Board, bearing the registrant's name and the legend "Registered Professional Engineer".

No plans, specifications, plates, and reports, issued by a registrant, shall be official unless sealed with his or her seal.

It shall be unlawful for any person to seal any documents if the certificate of the registrant named therein has expired or has been revoked.

Section 28.—State and Political Sub-Divisions to Employ Registered Professional Engineers on Public Work.—After the first day of....., one thousand nine hundred and....., it shall be unlawful for this State or for any of its political sub-divisions for any county, city, town, township, or borough to engage in the construction of any public work involving professional engineering, unless the plans and specifications and estimates have been approved by, and the construction supervised by, a registered professional engineer; provided, that nothing in this Section shall be held to apply to any public work wherein the contemplated expenditure for the completed project does not exceed two thousand ($2 000) dollars.

Section 29.—Penalties.—Any person required by this Act to become a registered professional engineer who shall, after the first day of..... one thousand nine hundred and....., practice or offer to practice professional engineering in this State without being so registered, or any person presenting or attempting to use as his own the certificate of registration of another, or any person who shall falsely inpersonate any other registrant of like or different name or any person who shall wilfully use or attempt to use a revoked certificate of registration, shall be guilty of a misdemeanor, and shall, upon conviction, be sentenced to pay a fine of not less than one hundred ($100) dollars nor more than five hundred ($500) dollars, or to suffer imprisonment for a period not exceeding three months, or both.

Section 30.—Repeal.—All acts and parts of acts of Assembly inconsistent with this Act are hereby repealed.

Annual Reports

ANNUAL REPORT OF THE BOARD OF DIRECTION FOR THE YEAR ENDING DECEMBER 31, 1924

In compliance with the Constitution, the Board of Direction presents its Report for the year ending December 31, 1924.

THE SEVENTY-SECOND YEAR

The following matters of which the membership has been notified are given briefly after which the standard activities of the Society are noted in greater detail.

Death of Secretary Dunlap

John H. Dunlap, Secretary of the Society, died on July 29, 1924, in Chicago, Ill., as a result of injuries received in a train collision on June 30, at Buda, Ill., while returning to Headquarters from the Pasadena Convention.

Election of Secretary Seabury

At the meeting of the Board of Direction held December 1, 1924, George T. Seabury, M. Am. Soc. C. E., was elected Secretary of the Society.

Death of Director Holland

Clifford M. Holland, Director of the Society, died October 27, 1924, at Battle Creek, Mich.

The Freeman Fund

At the meeting of the Board held in Pasadena, Calif., June 17, 1924, Past-President John R. Freeman announced a gift to the Society of a fund of $25 000 for the purpose of encouraging engineering investigations, with a view to giving special recognition and encouragement to young engineers.

The President has appointed a committee of three, consisting of Messrs. John R. Freeman, Thaddeus Merriman, and Leonard Metcalf, to consider a plan for the administration of the Fund.

It is the expectation of the Board that through this generous gift young engineers may be aided in experiments, observation and research, in order to secure new and accurate data relative to engineering.

Joint Conference Committee

The Joint Conference Committee, consisting of the Presidents and Secretaries of the Founder Societies, has held five meetings during 1924.

This Committee considers matters of interest common to the members of the Engineering Profession.

At the request of President Grunsky, Past-President Loweth served as Chairman of the Committee during the past year.

The Committee assisted in receiving several groups of young Italian engineers who were brought over to this country in accordance with the plans of Prince Caetani, Italian Ambassador. It was intended that these engineers should begin work as laborers, and so obtain practical experience in the industrial plants of America.

The Committee co-operated in the arrangements for the World Power Conference held in London in June, 1924, and also in the arrangements made for the International Management Congress held in Prague, Czechoslovakia, July, 1924.

Among the questions now before this Committee are the establishment of a National museum of engineering and industry; co-operation and co-ordination of local section and local engineering organization activities; compilation of data of engineering services, salaries, and fees.

MEETINGS OF THE BOARD OF DIRECTION

There have been seven meetings of the Board of Direction during 1924:

January 14-15, New York, N. Y.
January 17, New York, N. Y.
February 25, New York, N. Y.
April 7-8, Atlanta, Ga.
June 16-17, Pasadena, Calif.
October 21-23, Ann Arbor and Detroit, Mich.
December 1, Pittsburgh, Pa.

MEMBERSHIP

The changes in membership are shown in the following table:

	Jan. 1, 1924.			Jan. 1, 1925.			Losses.				Additions.		Totals.		
	Resident.**	Non-Resident.	Total.	Resident.**	Non-Resident.	Total.	Transfer.	Resignation.	Dropped.	Died.	Transfer.	Election.	Loss.	Gain.	Increase.
Honorary Members	2	11	13	3	10	13	0	0	0	1	0	1	1	1	...
Members	868	3 955	4 823	878	4 057	4 935	0	22	57	78	*144	‡125	157	269	112
Associate Members	843	4 454	5 297	862	4 458	5 320	143	43	169	31	†64	§345	386	409	23
Juniors	141	465	606	175	561	736	64	6	33	1	.....	‖234	104	234	130
Affiliates	59	101	160	59	99	158	1	2	6	3	.....	10	12	10	¶2
Fellows	4	5	9	4	4	8	0	0	0	1	0	0	1	0	¶1
Total	1 917	8 991	10 908	1 981	9 189	11 170	208	73	265	115	208	715	661	923	262

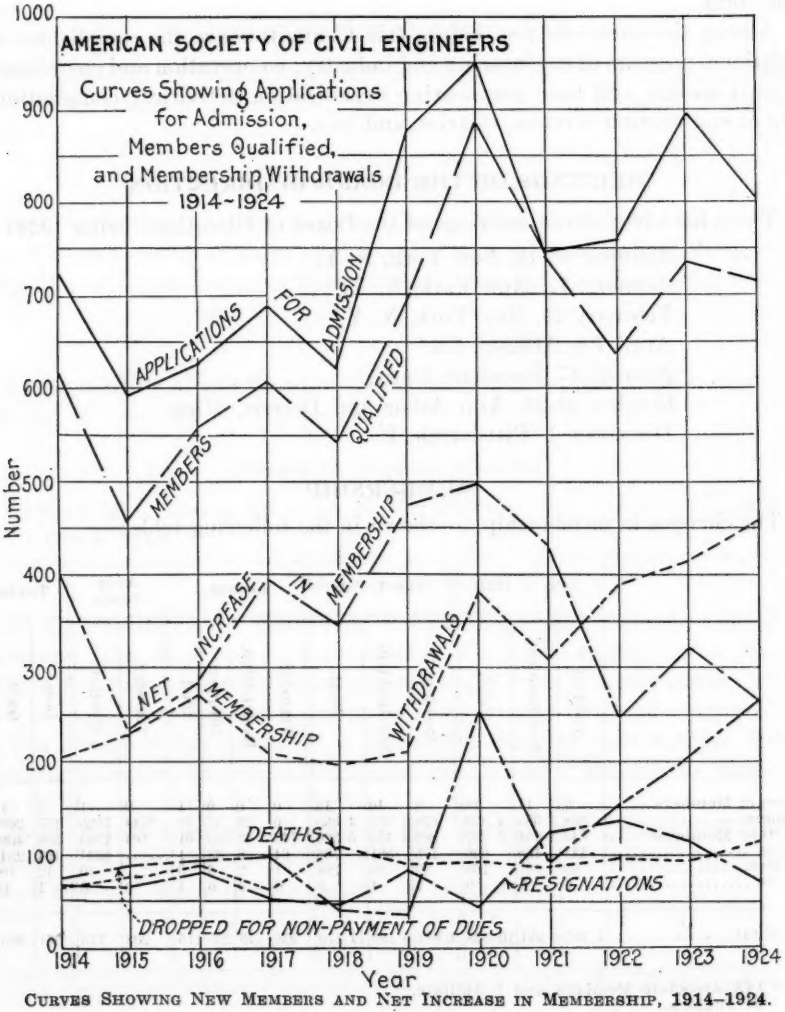
* 143 Associate Members and 1 Affiliate.
† 64 Juniors.
‡ 7 Reinstatements.
§ 6 Reinstatements.
‖ 1 Reinstatement.
¶ Decrease.
** Those residing within fifty miles of the City Hall, New York, N. Y.

The net increase in membership for the year is 262.

New Members and Net Increase

The following table shows the new members and the net increase during the past ten years. The accompanying diagram gives membership statistics for the same period.

	1915	1916	1917	1918	1919	1920	1921	1922	1923	1924
New Members.....	461	552	608	537	687	887	743	636	733	715
Net increase.....	231	283	398	343	475	499	435	246	320	262



CURVES SHOWING NEW MEMBERS AND NET INCREASE IN MEMBERSHIP, 1914–1924.

Applications for Membership

The total number of applications for membership has been 1 039, of which 800 are for admission and 239 for transfer.

Deaths

The losses by death during the year number 115 and are as follows:

Past Presidents and Present Officers (3):

Past President: John Augustus Ockerson.

Director: Clifford Milburn Holland.

Secretary: John Hoffman Dunlap.

Honorary Members (1): Sir Maurice Fitzmaurice.

Members (75): Albert Hilands Acher, John Cummings Auten, Henry Nash Babcock, James Hayward Bacon, Charles Hinckley Baker, William James Baldwin, Walter Francis Ballinger, Guion Victor Barril, Orville Benson, Daniel Bontecou, Dudley Digges Britt, Fred Asdel Bryan, Enrique Budge, Clinton Sumner Burns, Alexander Mosby Clayton Byers, Henry Marison Byllesby, Albert Carr, John Montgomery Coane, Andrew Arnold Cohill, Albert Ladd Colby, Arthur Bateman Corthell, Charles Leo Crandall, Benjamin Lincoln Crosby, Edward Benjamin Cushing, Edward Coe Dilworth, Charles Addison Ferry, Walter Joseph Francis, Robert Giles, Lewis Singer Gillette, John Wilson Hamilton, John Lyell Harper, Kenneth Phipson Hawksley, Robert Francis Hayward, Joseph Hofman, Alberto Angel Ibargüen y Pi, Albert William Johnston, Howard Murfree Jones, Wilber Macaulay Judd, William Voorhees Judson, John William Kendrick, Frank Montgomery Kerr, Frank Barr Knight, James Albro Lawrie, Nelson Peter Lewis, Harry Charles Lothholz, J. Y. McClintock, Charles Oscar McComb, George Washington McNulty, Charles Stewart Maurice, Ellis Bradford Noyes, Paul Cook Nugent, Locke McIndoe Perkins, Ambrose Vincent Powell, George Henry Preston, William Henri Vale Reimer, George Thomas Roberts, William Horatio Sanders, Walter Howard Sawyer, Amos Schaeffer, Edward Clapp Shankland, Henry DeWitt Smith, Jacob Stephen Spiker, James Townsend Taylor, David Gorton Thomas, Edward Chandler Tollinger, John Cresson Trautwine, Jr., Charles Hopkins Van Orden, Edward Franklin Vincent, Frank Thomas Westcott, George Chandler Whipple, Frederic Irving Winslow, Colin Reed Wise, Frank Coy Woodward, Eberhard John Wulff, Frederick Charles Young.

Associate Members (31): William Stuart Babcock, Juan Batiste Hipolyte Bardury, Frank Simmons Boothe, David Walker Brooks, Charlie Ellsworth Chester, John Sterling Deans, John Warren Du Bois Gould, Andrew Jenkins Hayes, John Paul Healy, Thomas Tyrrell Heiges, Robert Easton Hunter, William George Juengst, George Allen Kyle, Alonzo Church Lee, Bertrand Clifford Martin, Edward Gilbert Mathews, Hugh Lester Mayers, Emil Robert Olbrich, Thomas Patrick O'Shaughnessy, Arthur Southwick Page, Joel Marsh Pratt, Richard Barkley Reasoner, Leroy Tallman, Daniel Anderson Tomlinson, Frederick George Twitchell, Richard Dana Upham, George Lawrence Watters, Gaylord D. Weeks, Edward Hyde Wells, Jr., Peyton Brown Winfree, Joe Young Work.

Juniors: (1): Kenneth Louis Greeman.

Fellows (1): Biderman du Pont.

Affiliates (3): George Burnham, Jr., John Baptiste Lober, Coleman Meriwether.

ENGINEERING SOCIETIES LIBRARY

The Engineering Societies Library added during 1924 a total of 4 628 volumes (3 344 gifts, 1 284 purchases); 39 pamphlets (33 gifts, 6 purchases); and 78 maps (74 gifts, 4 purchases). The permanent collection contains 109 744 volumes, pamphlets, and maps.

Expenditures for books, periodicals, binding, supplies, and salaries were approximately $32 000. The Library was used by 35 911 persons, 23 414 of whom visited it.

During the year, 7 565 volumes were catalogued and 34 133 cards added to the catalog. This catalog now contains 231 928 cards, arranged under 24 064 subjects.

The Search Department attended to 460 inquiries, making 258 searches and 170 translations, totaling 287 310 words. The Photoprint Department made 24 968 photoprints for 2 722 persons. The receipts for these services, approximately $16 000, covered the cost.

Books were lent to 204 distant members.

READING ROOM OF THE SOCIETY

The attendance at the Reading Room during the year was 3 212.

A total of 295 periodicals are regularly received, and this number covers many foreign periodicals, including Chinese and Japanese. The literary magazines have proved of interest to the members, and a few newspapers have been added to the files.

The list of recent engineering articles of interest which is prepared monthly by the assistants in the Reading Room, contained 2 126 titles and covered 82 pages. Forty-eight periodicals were indexed.

The collection of books in this room, although small, has been selected with care, and a number of new titles have been added during the year.

EMPLOYMENT SERVICE

The Boards of the Founder Societies approved the new plan for operating the Employment Service of the Founder Societies, September 1, 1924. Under this plan:

1.—The use of the Service is limited to members of the Founder Societies, and to the members of those societies which shall become associated with the Founder Societies in the joint effort.

2.—Service is extended to all employers of engineers without charge.

3.—Listing of positions available is discontinued except for those that are difficult to fill. Instead of such listing, a weekly bulletin of positions, at a subscription of $3 quarterly, $10 per annum, is printed and made available to members of the Founder Societies, and to the members of co-operating societies.

4.—Publication of "Men Available" is continued in the various Society publications for members, without charge.

5.—Members obtaining positions through the Service are asked to co-operate in the financing by the payment of a nominal fee, on the following basis, $10 for all positions paying $2 000 or less per annum; $10 plus 1% of

all salary in excess of $2 000 per annum; temporary positions 3% of total salary received.

The results of the operation of the Service on this plan, together with the assistance received from the Founder Societies, has been sufficiently successful to make possible an offer to assist in establishing a local office in Chicago, Ill. This office will be a joint effort on the part of the Founder Societies and the Western Society of Engineers, and it is hoped that this service can be extended to other cities under a similar arrangement with other local societies, and, in this way, will become national in scope.

The number of men registered and placed during 1924 has averaged about 75 per month and is as follows:

	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Totals
Men registered.....	145	134	116	159	174	155	117	105	107	128	98	109	1 547
Men placed.....	118	70	60	83	71	106	64	82	47	94	63	66	924

COMMITTEES

The fourteen Special Committees authorized to report on engineering subjects are as follows:

To Codify Present Practice on the Bearing Value of Soils for Foundations (Authorized December 3, 1912).

Stresses in Railroad Track (Authorized November 12, 1913).

To Consider and Recommend for Adoption a Specification for Bridge Design and Construction (Authorized August 9, 1920).

Standard Construction Contracts (Authorized June 6, 1921).

Electrification of Steam Railways (Authorized January 16, 1922).

Impact in Highway Bridges (Authorized April 4, 1922).

Stresses in Structural Steel (Authorized April 4, 1922).

Flood Protection Data (Authorized April 4, 1922).

Irrigation Hydraulics (Authorized April 4, 1922).

Hydraulics Phenomena (Authorized April 4, 1922).

Concrete and Reinforced Concrete Arches (Authorized January 16, 1923).

Steel Column Research (Authorized January 16, 1923).

Effects of Earthquakes on Engineering Structures with Special Reference to the Japanese Earthquake of September 1, 1923 (Authorized October 16, 1923).

Cement (Authorized October 22, 1924).

Gifts for Committee Work

Gifts have been received for the work of the Special Committee on Concrete and Reinforced Concrete Arches: From Engineering Foundation $3 000, and from the Blaw Knox Company, $150. Through Engineering Foundation, the American Bridge Company and McClintic-Marshall Company have each contributed $750 for the work of the Special Committee on Steel Column Research. Of this amount $1 000 has been received by the Society.

There have also been contributions of services, facilities, equipment, etc., to several of the Committees by interested organizations; in many cases the value of these amounts to a very substantial figure.

The Board of Direction wishes again to express its appreciation of the generosity which prompted these gifts.

PUBLICATIONS

Ten numbers of *Proceedings,* one volume of *Transactions,* a Year Book, and a new edition of the pamphlet entitled "Aims and Activities", have been published in 1924.

The stock of the various publications of the Society kept on hand for the convenience of members and others now amounts to 84 959 copies, the cost of which to the Society for paper and press work only, has been $20 540.70.

The table (see page 91) shows the cost per page for text and illustrations in *Proceedings* and *Transactions* for the past twelve years.

Summary of Publications for 1924

	Issues	Average edition	Total pages	Plates	Cuts
Proceedings (monthly numbers)	10	11 750	2 612	8	407
Transactions, Vol. LXXXVII	1	11 500	1 515	8	498
Year Book	1	11 800	413	1	...
"Aims and Activities"	1	16 000	34	1	3
Total	13	.....	4 574	18	908

The cost of publications, as determined by the bills actually paid during the year, has been;

For Paper, Printing, etc., *Proceedings*	$25 882.10
For Paper, Printing, etc., of 11 400 Extra Copies of Papers, Discussions, Memoirs	842.78
For Paper, Printing, etc., *Transactions* Vol. LXXXVII	8 733.31
For 4 525 Extra Copies of Separate Papers for *Transactions* Vol. LXXXVII	845.66
For Binding, Envelopes, etc., *Proceedings*	5 795.93
For Binding,* Boxes, etc., *Transactions* Vol. LXXXVII	2 487.25
For Plates and Cuts	5 017.07
For Year Book	4 740.36
For "Aims and Activities"	957.72
For Copyright and Sundry Expenses	96.09
Total	$55 398.27
Deduct amount received from sale of publications	4 714.42
Net expenditures for publications for 1924	$50 683.85

* Paper binding only.

TABLE SHOWING NUMBER AND COST OF PAGES AND COST OF ILLUSTRATIONS FOR *Transactions* AND *Proceedings*.

Year.	*TRANSACTIONS.*				*PROCEEDINGS.*				*PROCEEDINGS and TRANSACTIONS.*			ILLUSTRATIONS.		
	Issues.	Edition.	PAGES.		Issues.	Edition.	PAGES.		Total pages.	Total cost.	Cost per page.	Cost.	Percentage of total cost.	Cost per page.
			Per volume.	Total.			Per volume.	Total.						
1913	1	7 700	2 302	17 740 000	10	7 625	3 184	24 280 000	42 020 000	$43 329.77	$0.00103	$3 964.16	9.1	$0.000094
1914	1	8 200	1 968	16 140 000	10	8 150	4 076	33 220 000	49 360 000	39 083.89	0.00079	2 968.32	7.6	0.000075
1915	2	8 600	3 130	26 900 000	10	8 425	3 668	30 900 000	57 800 000	47 984.16	0.00083	3 684.68	7.7	0.000064
1916	1	8 400	2 301	19 330 000	10	8 350	2 892	24 140 000	43 470 000	35 645.65	0.00082	1 403.12	3.9	0.000032
1917	..	.....	.....	.....	10	8 550	3 482	29 950 000	29 950 000	28 608.18	0.00097	3 708.97	12.9	0.000126
1918	1	8 700	1 879	16 340 000	10	8 950	2 341	20 950 000	37 290 000	33 785.64	0.00091	1 192.20	3.5	0.000032
1919	1	9 000	1 775	15 980 000	8	9 100	2 096	19 075 000	35 055 000	32 082.69	0.00091	1 128.53	3.5	0.000032
1920	..	.....	.....	.....	10	10 142	2 014	20 440 000	20 440 000	23 446.34	0.00115	2 552.27	10.9	0.000125
1921	2	10 000 10 500	2 479 993	35 212 000	10	10 680	1 684	19 450 000	54 662 000	66 298.39	0.00121	2 034.72	3.1	0.000037
1922	1	10 900	1 826	19 900 000	10	11 100	2 740	30 400 000	50 300 000	56 200.00	0.00112	3 700.00	6.6	0.000073
1923	1	11 200	1 808	20 250 000	10	11 500	3 210	36 915 000	57 165 000	60 612.88	0.00106	4 809.88	7.9	0.000084
1924	1	11 500	1 515	17 440 000	10	11 750	2 612	30 700 000	48 140 000	47 573.72	0.00099	4 579.04	9.6	0.000095

The subjects of the papers and discussions printed in *Proceedings* and *Transactions* during the year, and the number of pages devoted to each, follows:

	Transactions	*Proceedings*
City Planning	....	90
Dams	279	45
Engineering History	13	14
Geology	....	10
Highway Engineering	45	91
Hydraulics	78	68
Materials of Engineering	72	155
Mathematics	62	....
Railways	221	14
Rainfall	85	64
Sanitation	....	29
Sewage Disposal	....	70
Shore Protection	65	55
Structural Engineering	169	510
Water Power	....	75
Waterways	209	186
	1 298	1 476

MEETINGS

Ten meetings of 17 sessions, were held during the year, as follows: At the Annual Meeting, 1 (3 sessions); at the Spring Meeting at Atlanta, Ga., 1 (3 sessions); at the Annual Convention at Pasadena, Calif., 1 (2 sessions); at the Fall Meeting at Detroit, Mich., 1 (3 sessions); and 6 other meetings. All the New York meetings, including the Annual Meeting, were held at Society Headquarters in the Engineering Societies Building.

At these meetings there were presented 10 formal papers, 9 of which were illustrated with motion pictures and lantern slides, and 1 address.

During the year, there were also published 6 Progress Reports and 1 Final Report of Special Committees, all of which were presented at the Annual Meeting, and 6 papers that were not presented at any meeting of the Society, as well as the Report of the Joint Committee on Standard Specifications for Concrete and Reinforced Concrete.

The number of members and others who took part in the preparation and discussion of these papers, address, and the reports of the Special Committees, was about 216. This figure does not include those who took part in the preparation and discussion of papers presented at the meetings of the Technical Divisions which are listed on page 13.

The total attendance at the 10 meetings of the Society was about 3 094. The registered attendance at the Annual Meeting was 913; at the Spring Meeting, 453; at the Annual Convention, 779; and at the Fall Meeting, 482.

The meetings of the Society during the year, together with the papers, reports of Special Committees, etc., presented thereat, are, as follows:

January 16, 1924, Progress Reports of Special Committees on Impact in Highway Bridges, Stresses in Structural Steel, Fire Prevention of Docks, Piers, and Wharves, Bearing Value of Soils for Foundations, etc., Stresses in Railroad Track, Highway Engineering, Irrigation Hydraulics, Hydraulics

Phenomena, Standard Construction Contracts, Flood-Protection Data, Concrete and Reinforced Concrete Arches, and Steel Column Research, and the Final Report on Specifications for Bridge Design and Construction.

January 17, 1923, "Explorations in the Desert Region of Central Asia", by Dr. Charles P. Berkey, Professor of Geology, Columbia University, New York, N. Y.

February 6, 1924, "The Analysis of Stresses in the Ring of a Concrete Skew Arch", by J. Charles Rathbun, M. Am. Soc. C. E.

March 5, 1924, "The Hydraulic Design of the Shaft Spillway for the Davis Bridge Dam, and Hydraulic Tests on Working Models", by Ford Kurtz, M. Am. Soc. C. E.

April 9, 1924 (Two Sessions), "The Economics of Hydro-Electric Development", by Daniel W. Mead, M. Am. Soc. C. E., and "The Railroads and the Industrial Development of the South", by W. R. Cole, Esq.

May 7, 1924, "The Secondary Effects of Certain Important River Bridges on Local Traffic Conditions", by John A. Miller, Jr., Assoc. M. Am. Soc. C. E.

June 19, 1924, "The Colorado River Problem", by William Kelly, M. Am. Soc. C. E.

September 6, 1924, "The Design of a Multiple-Arch System and Permissible Simplifications", by A. C. Janni, M. Am. Soc. C. E.

October 23, 1924 (Two Sessions), "The St. Lawrence Deep Waterway to the Sea", by Francis C. Shenehon, M. Am. Soc. C. E.

November 5, 1924, "Secondary Stresses in Bridges", by Cecil Vivian von Abo, Jun. Am. Soc. C. E.

December 10, 1924, "Waterway and Railway Equivalents", by William M. Black, M. Am. Soc. C. E.

The papers published in *Proceedings,* but not presented at any meeting of the Society were, as follows:

January, 1924, "Beach Erosion: Its Causes and Cure", by Henry Clay Ripley, M. Am. Soc. C. E.

March, 1924, "Beams Without Lateral Support", by S. Timoshenko, Esq., and "Analysis of Railroad Grades for Classification", by S. Vilar y Boy, Assoc. M. Am. Soc. C. E.

April, 1924, "Analytical Solution of Masonry Domes", by David C. Coyle, Esq.

October, 1924, Report of the Joint Committee on Standard Specifications for Concrete and Reinforced Concrete.

November, 1924, "Design of Symmetrical Concrete Arches", by Charles S. Whitney, Assoc. M. Am. Soc. C. E.

December, 1924, "Flood Flow Characteristics", by C. S. Jarvis, M. Am. Soc. C. E.

MEDALS AND PRIZES

For the year ending July, 1924, prizes were awarded as follows:

The Norman Medal to Bernhard Faaborg Jakobsen, M. Am. Soc. C. E., for his paper entitled "Stresses in Multiple-Arch Dams".

The J. James R. Croes Medal to Joel DeWitt Justin, M. Am. Soc. C. E., for his paper entitled "The Design of Earth Dams".

The James Laurie Prize for the paper by Charles Metcalf Allen, M. Am. Soc. C. E. and I. A. Winter, Esq., entitled "Comparative Tests on Experimental Draft-Tubes".

The Arthur M. Wellington Prize to Rufus W. Putnam, M. Am. Soc. C. E., for his paper entitled "Modern Rail and Water Terminals with Reference to Chicago".

LOCAL SECTIONS

There are at present 44 Local Sections, two of which were organized during the year, as follows:

Central Illinois Section
Milwaukee Section

The President of the Society has visited more than twenty Sections during the past year, having been accompanied part of the time by the late Secretary Dunlap.

The allotments to Local Sections have been continued, and the amount paid to them in 1924 was $6 250.

TECHNICAL DIVISIONS

The Technical Divisions are assuming increasing importance in Society affairs, and they have been of great assistance during the past year, in the preparation and carrying out of programs at the Quarterly Meetings.

Meetings of the Power, Sanitary Engineering, Highway, Irrigation, and City Planning Divisions have been held at the Quarterly Meetings of the Society at New York, N. Y., Atlanta, Ga., Pasadena, Calif., and Detroit, Mich.

The number of members and others who took part in the preparation and discussion of papers presented at these meetings was about 155. The meetings of the Divisions during the year, together with the papers presented thereat, are, as follows:

Power Division

January 17, 1924, "Comparative Tests of Experimental Draft-Tubes",* by C. M. Allen, M. Am. Soc. C. E., and I. A. Winter, Esq.; and an Informal Discussion on "Absorption of Hydro-Electric Power by Existing Systems", by John P. Hogan, M. Am. Soc. C. E., and others.

April 10, 1924, "The Interconnected Power Systems of the Southeast",† by Charles G. Adsit, M. Am. Soc. C. E.

June 19, 1924, "Million-Volt Transformer in Relation to Power Transmission," by Professor Royal W. Sorenson.

October 24, 1924, "Outline of the Work of the Committee on Ice Problems at Hydro-Electric Plants", Francis C. Shenehon, M. Am. Soc. C. E., Chairman.

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* *Transactions*, Am. Soc. C. E., Vol. LXXXVII (1924), p. 893.
† *Proceedings*, Am. Soc. C. E., October, 1924, p. 1286.

Sanitary Engineering Division

January 17, 1924, "Distribution of Intense Rainfall and Some Other Factors in the Design of Storm-Water Drains",* by Frank A. Marston, M. Am. Soc. C. E.; and "Imhoff Tanks—Reasons for Differences in Behavior",† by Harrison P. Eddy, M. Am. Soc. C. E.

April 10, 1924, "Municipal Water Supply Problems of Atlanta, Ga.", by Paul H. Norcross, M. Am. Soc. C. E.

June 19, 1924, "The Tri-Cities Sewage Disposal Plant for the Cities of Pasadena, South Pasadena, and Alhambra, Los Angeles County, California", by Robert V. Orbison, M. Am. Soc. C. E.; and "Sewage Disposal for the Los Angeles Metropolitan District", by Willis T. Knowlton, M. Am. Soc. C. E.

October 24, 1924, "Recent Developments in English Sewage Treatment", by Robert L. Sackett, M. Am. Soc. C. E.; "Treatment of the Sewage of Chicago", by Langdon Pearse, M. Am. Soc. C. E.; "Sewage Disposal Problems in the Detroit Area", by Clarence W. Hubbell, M. Am. Soc. C. E.; and "Water Supply Problems in the Detroit Area", by George H. Fenkell, M. Am. Soc. C. E.

Highway Division

January 17, 1924, "Researches of the U. S. Bureau of Public Roads on the Structural Design of Highways,"‡ by A. T. Goldbeck, Assoc. M. Am. Soc. C. E.; and "Highway Research in Illinois",§ by Clifford Older, M. Am. Soc. C. E.

April 10, 1924, "Highway Maintenance Costs and Problems", by W. R. Neel, M. Am. Soc. C. E.

June 19, 1924, "Development of Highway Traffic in California", by L. I. Hewes, M. Am. Soc. C. E.

October 24, 1924, "Highway Transportation Surveys", by J. G. McKay, Esq.; and "Traffic Regulation on State Highways", by Frank T. Sheets, M. Am. Soc. C. E.

City Planning Division

January 17, 1924, "Increasing the Capacity of Existing Streets",‖ by Arthur S. Tuttle, M. Am. Soc. C. E.

June 19, 1924, "The Influence of the Automobile on Regional Transportation Planning", by George A. Damon, Esq., and "Regional Aspects of Planning Streets and Highways for Modern Transportation", by E. E. East, Esq.

October 24, 1924 (First Session): "Factors in the Zoning of Cities": The Health Bases of Zoning", by the late George C. Whipple, M. Am. Soc. C. E.; "Zoning for Use", by Edwin A. Fisher, M. Am. Soc. C. E.; "Zoning for Height", by Jacob L. Crane, Jr., M. Am. Soc. C. E.; "Zoning for Area", by Har-

* *Transactions*, Am. Soc. C. E., Vol. LXXXVII (1924), p. 535.
† *Proceedings*, Am. Soc. C. E., May, 1924, p. 6.
‡ *Proceedings*, Am. Soc. C. E., April, 1924, p. 453.
§ *Transactions*, Am. Soc. C. E., Vol. LXXXVII (1924), p. 1180.
‖ *Proceedings*, Am. Soc. C. E., May, 1924, p. 593.

land Bartholomew, M. Am. Soc. C. E.; "Building Line Zoning". by Lawrence V. Sheridan, M. Am. Soc. C. E., and Clyde T. Hoffman, Esq.; "Family Density-Regulation", by Robert Whitten, Esq.; and "The Administration of Zoning Ordinances", by Morris Knowles, M. Am. Soc. C. E.

October 25, 1924 (Second Session), "The Influence of Zoning on the Design of Public Utilities": "Transportation", by J. Roland Bibbins, Esq.; "Drainage", by Paul Hansen, M. Am. Soc. C. E.; "The Street System", by T. Glenn Phillips, Esq.; "The Telephone System", by Albert P. Allen Esq.; "The Water Supply", by H. Malcolm Pirnie, M. Am. Soc. C. E.; and "Recreation Facilities", by C. E. Brewer, Esq.

Irrigation Division

On June 19, 1924, a Business Meeting of the Irrigation Division was held at Pasadena, Calif.

Structural Division

During the year a new Technical Division, the Structural Division, was authorized, and 702 members have requested to be enrolled as members. The organization meeting will be held during the Annual Meeting of 1925.

Membership of Divisions

The interest taken by the membership in the Technical Divisions is plainly shown in the increase in membership from 1 861 in 1923, to 3 728 at present.

The membership of these Divisions is as follows:

City Planning Division	443
Highway Division	1 027
Irrigation Division	424
Power Division	377
Sanitary Engineering Division	755
Structural Division	702
Total	3 728

STUDENT CHAPTERS

There are at present 36 students who have taken advantage of the By-Law which enables them to continue affiliation with their Chapters until the first day of the second January following graduation.

New Student Chapters

There are now 69 Student Chapters, 5 of which were organized during the year:

Agricultural and Mechanical College of Texas
Missouri School of Mines and Metallurgy
State College of Washington
University of Southern California
University of Utah

The Rose Polytechnic Institute Student Chapter was disbanded by the Board during the year.

The Annual Reports of the Student Chapters contain many matters of interest, and eleven of these reports have been selected for special mention.

California Institute of Technology

This has been the most successful year of the Chapter as a higher percentage of those registered in the Civil Engineering course are active members, than in any previous year. Plans for a hike to inspect the sites of the flood control dams and reservoir in the San Gabriel Canyon are being made as well as plans for a joint meeting with the Los Angeles Section.

Carnegie Institute of Technology

In addition to talks by visiting engineers various addresses have been given by student members on technical and non-technical subjects. A Senior has charge of the program and is assisted in his discussion by one Junior and two Sophomores.

Clemson Agricultural and Mechanical College

Lectures are being given by students who are in a contest known as the "Illustrated Lecture Contest". The Chapter has offered a prize to the student who gives the best lecture.

College of the City of New York

The Society undertook an engineering project, known as the Van Cortlandt Park Project, which consisted in converting part of the Park into a suburban town. The members formed themselves into an engineering organization, the Seniors acting as Chief Engineers of a specific phase of the project, while the other members worked under their supervision.

The Chapter also undertook to revise the curriculum of the School of Technology. The report was praised by the Faculty, and many of the changes recommended were adopted.

Cornell University

The twenty-third annual banquet of the School of Civil Engineers was held in the Prudence Risley Banquet Hall as part of the activities of the Student Chapter. More than 170 students, faculty members, and local engineers attended.

Iowa State College

During a three-day college exposition the Civils built and operated in miniature the Minneapolis Power Project. They had an instrument show, a road show, decorated two floats, and ran a carnival stunt. The judges awarded the Civils first prize.

During the home-coming celebration the members operated a large electric sign. They also put out a departmental publication called the *Tripod*.

Oregon State Agricultural College

This Chapter reports a very full program of technical papers. The three prizes offered by the Portland, Oregon, Section for the best papers discussing some problem which has come under research or the personal observation of the competitors were awarded.

Stadia Club (University of Oklahoma)

This Student Chapter endeavors to take a very active part in the student activities of the Engineering School. It attempts to make all meetings both entertaining and educational. An attempt is also made to make contacts between the students and the profession out of school.

Stanford University

This Chapter is raising a Scholarship Fund, the proceeds of which are to be used toward the support of some deserving Senior Civil Engineer Student.

Every member of the Chapter attended a joint meeting with the San Francisco Section and the Student Chapter of the University of California in San Francisco on October 21.

An Alumni Directory and Year Book was published by the Chapter in June, 1924.

University of Michigan

The members of the Student Chapter were invited to the banquet given to the Board of Direction of the Society at Ann Arbor on October 21, and many of them availed themselves of the opportunity to attend the Fall Meeting of the Society held at Detroit during the same week.

University of Minnesota

Two prizes have been offered by the Northwestern Section for the two best papers presented by members of the Chapter.

FINANCES

The finances of the Society are in good condition. The balance of cash on hand, exclusive of sums held in trust for certain Special Committees and Technical Divisions, is approximately $51 000, as against $25 000 at the end of 1923. Since the beginning of the year cash on hand has increased about $26 000, and, in addition, $10 000 has been added to the Reserve Fund.

The reports of the Secretary and the Treasurer are appended.

By order of the Board of Direction.

January 19, 1925. GEORGE T. SEABURY, *Secretary.*

REPORT OF THE TREASURER OF THE AMERICAN SOCIETY OF CIVIL ENGINEERS FOR THE YEAR ENDING DECEMBER 31, 1924

In compliance with the provisions of the Constitution, I have the honor to present the following report:

Cash on Hand, January 1, 1924		$36 668.30
Receipts		
From current sources, January 1 to December 31	$255 761.00	
1924 Dues collected for Power Division	262.00	
1925 " " " " "	134.00	
Rent from 57th Street Property	22 703.32	
To establish the Rudolph Hering Medal	450.00	
From Engineering Foundation for:		
Special Committee on Concrete and Reinforced Concrete Arches*	3 150.00	
Special Committee on Steel Column Research†	1 000.00	
Maturity of One 5½% U. S. Treasury Note	10 000.00	
Maturity of One 4% U. S. Treasury Note	10 000.00	
The Freeman Fund Investments	35.00	303 495.32
Disbursements		
Payment of Bills by audited vouchers for current business January 1–December 31	$240 367.50	
Local Sections	6 250.00	
Technical Divisions	2 974.49	
Purchase of:		
Two $10 000 U. S. Treasury Notes. $20 109.38		
Accrued Interest 309.36	20 418.74	
One $10 000 Certificate of Deposit	10 000.00	
Final Payment on alterations to 57th Street Curb	208.57	
Balance on hand December 31, 1924:		
In Garfield National Bank $54 444.32		
In hands of Secretary 5 000.00		
In Chase National Bank 500.00	59 944.32	
	$340 163.62	$340 163.62

Respectfully submitted,

OTIS E. HOVEY,
Treasurer.

* Contributed by Engineering Foundation $3 000.00
" " Blaw-Knox Company 150.00 $3 150.00

† " " American Bridge Co. $ 500.00
" " McClintic-Marshall Co. 500.00 1 000.00

REPORT OF THE SECRETARY FOR THE

TO THE BOARD OF DIRECTION OF THE

GENTLEMEN:—I have the honor to present a statement of Receipts and Disbursements for the fiscal year of the Society, ending December 31, 1924. There is also appended a general Balance Sheet showing the condition of the affairs of the Society.

Respectfully submitted,

GEORGE T. SEABURY,
Secretary.

RECEIPTS.

Balance on hand January 1, 1924*		$36 668.30
Entrance Fees	$16 145.00	
Current Dues	148 145.97	
Past Dues	9 897.05	
Advance Dues	52 903.22	
Sale of Publications	4 714.42	
Binding of *Transactions*	7 809.24	
Badges	5 023.25	
Certificates of Membership	701.42	
Annual Meeting	3 682.67	
1924 Dues Collected for Power Division	262.00	
1925 Dues Collected for Power Division	134.00	
Interest on Bank Balance	1 198.64	
Interest on Investments	3 214.81	
Accrued Interest	309.36	
Postage	60.52	
Miscellaneous	1 935.18	
Rent from 57th St. Property	22 703.32	
To establish the Rudolph Hering Medal	450.00	
Eads Memorial Fund	20.25	
From Engineering Foundation in Credit to Special Committee on Concrete and Reinforced Concrete Arches†	3 150.00	
Special Committee on Steel Column Research‡	1 000.00	
Maturity of one 5½% U. S. Treasury Note	10 000.00	
Maturity of one 4% U. S. Treasury Note	10 000.00	
The Freeman Fund Investments	35.00	303 495.32
		$340 163.62

*Society Funds	$19 553.36	
Petty Cash (in hands of Secretary)	5 000.00	$24 553.36
For Special Committee on Stresses in Railroad Track		7 115.25
For Special Committee on Steel Column Research		796.42
For Eads Memorial Committee		2 739.75
1923 Dues Collected for Power Division	$243.80	
1924 Dues Collected for Power Division	92.00	335.80
To Establish the Rudolph Hering Medal		1 127.72
		$36 668.30

†Contributed by Engineering Foundation	$3 000.00	
Contributed by Blaw Knox Co	150.00	$3 150.00
‡Contributed by American Bridge Co.	$500.00	
Contributed by McClintic-Marshall Co	500.00	$1 000.00

YEAR ENDING DECEMBER 31, 1924

AMERICAN SOCIETY OF CIVIL ENGINEERS.

DISBURSEMENTS.

Salaries of Officers		$11 003.22	
Retirement Allowances		7 500.00	
Clerical Help		53 194.61	
Publications		55 398.27	
Binding of *Transactions* (Vol. 87)		4 604.00	
General Printing		2 621.27	
Badges		3 170.60	
Certificates of Membership		473.14	
Annual Prizes		236.87	
Meetings:			
Annual Meeting		7 926.47	
Annual Convention		1 333.90	
Annual Spring Meeting		1 362.99	
Annual Fall Meeting		1 477.88	
Monthly Meetings		1 210.53	
Local Sections		6 250.00	
Technical Divisions:			
Sanitary Engineering		925.45	
Power		665.07	
Irrigation		55.05	
Highway		639.05	
City Planning		689.87	
Traveling Allowance of Officers		17 024.83	
Traveling Allowance of Standing Committees		853.50	
Work of Committees		13 565.82	
Reading Room		435.27	
Employment Service		1 815.00	
Office Supplies		3 908.81	
Postage		9 293.01	
Furniture and Office Equipment		5 199.27	
Current Business		6 737.81	
U. E. S.:			
General Assessment		6 447.96	
Library		8 000.00	
Telephone		1 060.04	
John Fritz Medal Board		163 22	
Interest on Mortgage		10 000.00	
Premium on Insurance		148.71	
Miscellaneous		1 440.50	
Eads Memorial Fund		2 760.00	
Purchase of:			
Two $10 000 U. S. Treasury Notes	$20 109.38		
Accrued Interest	309.36	20 418.74	
One $10 000 Certificate of Deposit		10 000.00	
Alterations to 57th St. Curb (final)		208.57	
Amount transferred to Chase National Bank		500.00	
		$280 719.30	
Less Amount transferred to Chase National Bank		500.00	$280 219.30
December 31, 1924, Cash on Hand*			59 944.32
			$340 163.62

*Society Funds in Garfield National Bank	$45 189.30	
Petty Cash (in hands of Secretary)	5 000.00	
In Chase National Bank	500.00	$50 689.30
For Special Committee on Stresses in Railroad Track		4 856.10
For Special Committee on Concrete and Reinforced Concrete Arches		1 361.55
For Special Commmittee on Steel Column Research		707.85
1923 Dues Collected for Power Division	$243.80	
1924 Dues Collected for Power Division	354.00	
1925 Dues Collected for Power Division	134.00	731.80
To establish the Rudolph Hering Medal		1 562.72
For the Freeman Fund		35.00
		$59 944.32

GENERAL BALANCE SHEET

ACCOMPANYING THE REPORT

ASSETS

Real Estate:			
One-fourth interest in U. E. S. real estate, 25 to 33 West 39th Street, New York, N. Y.		$491 642.36	
220 West 57th St., New York, N. Y. Three lots (actual cost $185 406.20) Estimated Value		350 000.00	
Building with Improvements at Cost.	$242 029.99		
Less reserve for depreciation	63 851.01	178 178.98	$1 019 821.34
Equipment:			
Furniture and office equipment		$56 212.39	
Less reserve for depreciation		25 939.41	30 272.98
Library:			
Cash expended for books, etc		$22 122.22	
Donations (estimated)		72 310.83	94 433.05
Investments:			
$10 000 4¼% New York City bonds (at par)		$10 000.00	
27 300 4¼% Liberty Bonds (at cost)		27 007.25	
25 000 4¼% U. S. Treasury Notes (at cost)		25 015.63	
10 000 2½% Certificate of Deposit (at cost)		10 000.00	
The Freeman Fund:			
240 shares of miscellaneous stocks (at market value)		21 375.00	93 397.88
Working Assets:			
Publications on hand (book inventory) (at cost)		$20 540.70	
Unexpired insurance premiums		134.17	20 674.87
Current Assets:			
Cash on hand	$45 689.30		
Petty cash, in hands of Secretary	5 000.00	$50 689.30	
For Committee on Stresses in Railroad Track		4 856.10	
" " " Concrete and Reinforced Concrete Arches		1 361.55	
For Committee on Steel Column Research		707.85	
1923 dues collected for Power Division.	$243.80		
1924 " " " " "	354.00		
1925 " " " " "	134.00	731.80	
To establish the Rudolph Hering Medal		1 562.72	
For the Freeman Fund		35.00	59 944.32
Due from members		$29 113.81	
" " non-members		2 370.94	31 484.75
Interest accrued on investments to December 31, 1924			406.48
			$1 350 435.67

We have audited the accounts of the AMERICAN SOCIETY OF CIVIL estimate of the property valuations and book inventory of publications on hand correctly the financial condition of the Society at that date.

NEW YORK, January 14, 1925.

DECEMBER 31, 1924.

OF THE SECRETARY.

LIABILITIES

1925 dues paid in advance (including $134 for Power Division).		$53 037.22
Interest accrued on mortgage to December 31, 1924.....		4 166.70
Unexpended balance for Committee on Stresses in Railroad Track		4 856.10
" " " " " Concrete and Reinforced Concrete Arches.....		1 361.55
Unexpended balance for Committee on Steel Column Research..		707.85
1923 dues credited to Power Division.....	$244.00	
1924 " " " " "	373.00	617.00
Received to establish the Rudolph Hering Medal.....		1 562.72
Unexpended balance of income from Freeman Fund.....		35.00
Mortgage payable, due February 1, 1929.....		200 000.00
Funds:		
Herbert Steward Library Fund.....	$ 2 000.00	
Joseph G. Swift " "	1 000.00	
Compounding Dues Fund.....	15 480.00	
Norman Medal Fund.....	1 000.00	
Rowland Prize Fund.....	1 222.50	
Collingwood Prize Fund.....	1 000.00	
Arthur M. Wellington Prize Fund.....	2 150.00	
Fellowship Fund.....	13 038.28	
Hiram F. Mills Legacy.....	2 000.00	
The Freeman Fund.....	21 375.00	
Reserve Fund.....	33 132.10	93 397.88
Surplus.....		990 693.65
		$1 350 435.67

ENGINEERS for the year ended December 31, 1924, and (assuming that the are correct) we certify that, in our opinion, the above balance sheet sets forth

LYBRAND ROSS BROS. & MONTGOMERY,
Accountants and Auditors.

ANNUAL REPORTS OF THE TECHNICAL DIVISIONS

Annual Report of the City Planning Division for 1924

The City Planning Division of the American Society of Civil Engineers respectfully submits to the Board of Direction this report of operations for the year 1924.

At the beginning of the year the membership numbered 92. During the year this enrollment has increased to 445, making a group which should be of marked use to the City Planning activities of the United States. The loss of Mr. Nelson P. Lewis, Secretary John H. Dunlap, and Professor George C. Whipple has proved a serious handicap.

During the year programs were prepared for the Annual Meeting, the Pasadena Convention, and the Detroit Meeting. The papers presented at the Detroit Meeting were noteworthy, in that they constituted the most comprehensive series of zoning addresses which have been presented.

Three circular letters advising the members of the progress of the work were issued during the year, in January, October, and December. The information thus given out needs no repetition in this report.

The intended classification of the membership in relation to their special interests in the topics of City Planning has not yet been accomplished, but the questionnaire which is to be sent out is under advisement.

The outstanding need of the Division is a greater interest in the suggestion of subjects for Division meetings and a willingness to prepare suitable papers for these programs.

EDWIN A. FISHER, *Chairman,* Executive Committee,
CHARLES B. BALL, *Secretary.*

Annual Report of the Highway Division for 1924

During the year 1924 the activities of the Highway Division have been directed by an Executive Committee consisting of Messrs. C. J. Bennett, W. K. Hatt, Clifford Older, H. G. Shirley, and C. D. Curtiss. Mr. Shirley has served as Chairman and Mr. Curtiss as Secretary.

The Executive Committee held two meetings during 1924. The first was held in Washington, D. C., on January 23. This was attended by Messrs. Hatt, Shirley, and Curtiss. After organizing with the officers indicated above, plans were made for holding quarterly meetings during the year. Tentative programs were agreed on and the Division Secretary was authorized to proceed with the detailed arrangements.

The second meeting of the Executive Committee was held in Washington, August 12, and was attended by Messrs. Hatt, Shirley, and Curtiss. A few changes were made in the tentative program for the Fall Meeting and a two-session program planned for the Annual Meeting in New York. In accordance with the Constitution of the Highway Division the following Nominating

Committee was appointed to make nominations for members of the Executive Committee for 1925: C. J. Tilden, *Chairman,* H. K. Bishop, W. H. Connell, F. T. Sheets, and C. M. Upham.

This Committee nominated the following: Messrs. T. R. Agg, L. D. Blauvelt, C. D. Curtiss, H. G. Shirley, and T. J. Wasser. These names were sent out for letter-ballot to members of the Division and the results will be canvassed January 19, 1925.

Four meetings of the Division have been held in connection with the Annual Meeting and the regular Quarterly Meetings of the Society.

The first meeting was held at the Engineering Societies Building in New York, N. Y., January 17, 1924, in connection with the Seventy-first Annual Meeting of the Society. At the morning session, following the reading of the Annual Report of the Division Secretary, A. T. Goldbeck, Assoc. M. Am. Soc. C. E., Chief, Division of Tests, U. S. Bureau of Public Roads, gave a talk, illustrated with lantern slides, on "Researches of the United States Bureau of Public Roads on the Structural Design of Highways."* At the afternoon session, H. E. Breed, M. Am. Soc. C. E., read a paper prepared by Clifford Older, M. Am. Soc. C. E., formerly Chief Highway Engineer, Division of Highways of Illinois, on "Highway Research in Illinois."† Both these papers have been published by the Society and constitute a valuable addition to technical highway literature. The sessions were well attended considering the fact that the American Road Builders Convention was in progress in Chicago, Ill., at the same time.

The second meeting was held in Atlanta, Ga., on April 10, in connection with the Spring Meeting of the Society. W. R. Neel, M. Am. Soc. C. E., State Highway Engineer of Georgia, read an excellent paper on "Highway Maintenance Costs and Problems." This was followed by the presentation of written discussions by H. K. Bishop, M. Am. Soc. C. E., Chief, Division of Construction, U. S. Bureau of Public Roads, and Charles H. Moorefield, State Highway Engineer of South Carolina. These discussions were followed by a number of short discussions from the floor. Two motion picture films entitled "Roads to Wonderland" and "Tests for Better Roads", furnished through the courtesy of the U. S. Bureau of Public Roads, were shown. The meeting was very successful, the subject under discussion being an important one, which brought out considerable discussion from the floor.

The third meeting was held in Pasadena, Calif., June 19, in connection with the Fifty-fourth Annual Convention of the Society. J. S. Bright, M. Am. Soc. C. E., read a paper on "Development of Highway Traffic in California", prepared by L. I. Hewes, M. Am. Soc. C. E., Deputy Chief Engineer, U. S. Bureau of Public Roads. The presentation of this paper was followed by the reading of written discussions by A. E. Loder, Manager, Road Bureau, California State Automobile Association, Watt L. Moreland, President, Moreland Motor Truck Company, and Thomas E. Stanton, Jr., M. Am. Soc. C. E., Assistant State Highway Engineer of California. This program provided a well rounded discussion, the subject being covered, as it was, by representa-

* *Proceedings,* Am. Soc. C. E., April, 1924, Papers and Discussions, p. 453.
† *Transactions,* Am. Soc. C. E., Vol. LXXXVII (1924), p. 1180.

tives of the Federal Government, the State Highway Department, the State Automobile Association, and a truck manufacturer. Following the discussion, motion pictures, furnished through the courtesy of the U. S. Bureau of Public Roads, were shown.

The fourth meeting was held in Detroit, Mich., October 24, in connection with the Fall Meeting of the Society. Dr. J. G. McKay, Chief, Division of Highway Economics, U. S. Bureau of Public Roads, read a paper on "Highway Transportation Surveys." This paper was discussed by W. A. Van Duzer, M. Am. Soc. C. E., Equipment and Transport Engineer, Pennsylvania Highway Department, and H. G. McGee, Assoc. M. Am. Soc. C. E., Director, Municipal Research Bureau, Akron, Ohio. This was followed by a discussion of the subject "Traffic Regulation on State Highways", by John N. Mackall, Chairman and Chief Engineer, Maryland State Roads Commission; G. C. Dillman, Assoc. M. Am. Soc. C. E., Deputy Commissioner and Chief Engineer, Michigan State Highway Department, and A. H. Blanchard, M. Am. Soc. C. E., Professor of Highway Engineering and Highway Transport, University of Michigan. This meeting was well attended and lasted about 2½ hours.

The Highway Division has made a successful start. Excellent programs have been provided for all the Quarterly Meetings. The principal speakers have prepared very worthy discussions of current subjects of importance. Those fortunate enough to be able to attend the meetings have been well repaid. Less than 10% of the Division membership, however, have attended any one meeting.

In order to serve the 90% or more of the members who will never be able to attend meetings, some means should be found to make available within a reasonable time the papers presented. At the first meeting of the Highway Division after its organization the consensus of opinion of those present was that the Division could best serve its members and the Society in general by holding meetings in connection with the Quarterly Meetings of the Society and by making use of *Proceedings* and *Transactions* in putting before the membership papers and discussions covering important highway subjects and outstanding developments in highway research. The meetings have been held, but, thus far, the papers presented at only one meeting have been printed in *Proceedings*. It has been stated, however, that another one, that by Dr. Hewes, will appear in an early issue.*

A new procedure has been adopted by the Committee on Technical Activities and Publications which it is hoped will result in making all the Division papers of real merit available to the membership through publication in *Proceedings*.

A question of policy has arisen which will come before the new Executive Committee for consideration at once. This is the matter of continuing to hold Division meetings at each of the Quarterly Society Meetings. Of necessity, the various Division meetings have been held simultaneously. Many are members of more than one Division and are interested in the programs of several, but it is only possible to attend one meeting. Such conflicts are unfortunate. Then, too, it is questionable whether with the many other organi-

* See Papers and Discussions, p. 377.

zations holding similar meetings, the Highway Division can continue to provide programs of real merit as often as four times yearly. The Executive Committee, of course, desires to make plans in accordance with the wishes of the members.

C. D. CURTISS,
Secretary, Executive Committee.

Annual Report of the Executive Committee of the Irrigation Division, 1924

During the year 1924 the Irrigation Division of the American Society of Civil Engineers has confined its entire attention to the committee work outlined in the report of 1923, the results of which are to be presented at the Summer Meeting of 1925 in Salt Lake City, Utah. The Committees are as follows:

Committee on Interstate Water Matters;
Committee on Duty of Water Studies;
Committee on Co-operation between Federal and State Agencies;
Committee on Drainage of Irrigated Lands;
Committee on Relation of Irrigation to Power Demands;
Committee on Irrigation Economics;
Committee on Land Settlement Problems.

The scope of their activities was outlined to the members of the Division by the Chairman at the Division meeting in Pasadena, Calif., June 19, 1924.

In accordance with the Constitution, the following names were placed in nomination for the Executive Committee of 1925: Harold Dearborn Comstock, Riverton, Wyo.; Bernard Alfred Etcheverry, Berkeley, Calif.; Augustus Griffin, Brooks, Alberta, Canada; L. M. Holt, Yakima, Wash., and Augustus Kempkey, San Francisco, Calif.

It is the intention that the work of the sub-committees on technical subjects in preparation for the Salt Lake City meeting will be carried forward by the new Executive Committee.

THOMAS H. MEANS, *Chairman*, Irrigation Division,
F. H. FOWLER, *Secretary*.

Annual Report of Power Division for 1924

The Power Division was organized two years ago, at the Annual Meeting of the Society, in accordance with rules laid down by the Board of Direction, for the formation of Technical Divisions. The object of the formation of these Technical Divisions was mainly to provide opportunity for intensive discussion and presentation of subjects of particular interest to those practicing in certain branches, which opportunity could not be given in the general program. The work of this Division in the past two years and especially the last year has more than justified the action of the Board of Direction.

The work of the Division for 1924 was carried on under the direction of the Executive Committee, consisting of: Messrs. Nathan C. Grover, *Chairman*, Chief Hydraulic Engineer, U. S. Geological Survey, Washington, D. C.; Arthur P. Davis, Chief Engineer and General Manager, East Bay Municipal Utility District, Oakland, Calif.; John P. Hogan, Consulting Engineer, New York, N. Y.; Daniel W. Mead, Professor of Hydraulic and Sanitary Engineering, University of Wisconsin, and Consulting Engineer, Madison, Wis.; and George A. Orrok, Consulting Engineer, New York, N. Y.

The programs of the Division at the four general meetings of the Society during 1924 were:

Annual Meeting, New York, N. Y., January 17: "Comparative Tests on Experimental Draft-Tubes",* by C. M. Allen, M. Am. Soc. C. E., Professor of Hydraulic Engineering, Worcester Polytechnic Institute, Worcester, Mass., and I. A. Winter, Esq., Engineer, Southern Alabama Power Company, Birmingham, Ala.; and "Absorption of Hydro-Electric Power by Existing Systems", by John P. Hogan, M. Am. Soc. C. E., Consulting Engineer, New York, N. Y., and William B. Jackson, M. Am. Soc. C. E., Rate Engineer, New York Edison Company, New York, N. Y.

Spring Meeting Atlanta, Ga., April 10: "The Interconnected Power Systems of the Southeast",† by Charles G. Adsit, M. Am. Soc. C. E., Vice-President and Executive Engineer, Georgia Railway and Power Company, Atlanta, Ga.

Annual Convention Pasadena, Calif., June 19: "Million-Volt Transformer in Relation to Power Transmission", by Royal W. Sorensen, Professor of Electrical Engineering, California Institute of Technology, Pasadena, Calif.

Fall Meeting Detroit, Mich., October 24: "Ice Formation", by John Murphy, Electrical Engineer, Department of Railways and Canals, Ottawa, Canada.

To date, as noted, the papers by Messrs. Allen and Winter and Adsit have been published.

The Division has two Committees at work on very important problems, one on Deposits Caused by Dams, of which Thorndike Saville, Assoc. M. Am. Soc. C. E., is Chairman, the other on Ice Problems, with Francis C. Shenehon, M. Am. Soc. C. E., as Chairman.

The Committee on Deposits Caused by Dams was constituted in March, 1924, to collect information in the United States relative to silting, as the result of a request for such data by the Hydro-Technical Society of France. This Commiteee is endeavoring to secure the requisite information by means of questionnaires addressed to power companies and to others throughout the country.

The Committee on Ice Problems has been organized and is now attempting to lay out a program that will enable it to co-operate with various other agencies working to the same end.

The Executive Committee held five meetings during 1924 to propose programs, secure papers, and co-ordinate the work of this Division with that of the Committee on Technical Activities and Publications of the Society, which

* *Transactions*, Am. Soc. C. E., Vol. LXXXVII (1924), p. 893.

† *Proceedings*, Am. Soc. C. E., October, 1924, Papers and Discussions, p. 1286.

has final approval of Division programs. As it has been necessary to consider programs for meetings from six months to a year in advance, the Committee has had to expend a great deal of energy and persuasion to secure the necessary papers.

It has been greatly hampered by the wide geographical distribution of its membership. The expense and time involved in bringing together the full Committee has been prohibitive, and powers had to be delegated to two or three members who could confer with each other and preferably with the Secretary at Society Headquarters. For the good of the Division, some consideration should be given to this situation in the nomination of members of the Executive Committee in order to insure a working organization. Although, of course, not essential, some advantage will follow if at least two members of the Committee reside within easy reach of Society Headquarters.

The financial statement for the year 1924 is as follows:

Receipts

Balance on hand from 1923	$ 243.80
Appropriation by Society	700.00
Dues collected	262.00
Total	$1 205.80

Disbursements

Executive Committee meetings	$ 82.08
Division meetings	361.77
Special Committee work	134.97
Miscellaneous administrative expense	86.25
Unexpended balance reverting to Society	34.93
Balance on hand January 1, 1925	505.80
Total	$1 205.80

E. W. MALONEY,
Secretary.

Annual Report of the Executive Committee of the Sanitary Engineering Division for 1924

For the Sanitary Engineering Division, 1924 marked the second full year of its existence. The activity of the Division, the interest displayed by its members in the preparation and presentation of papers, and the large attendance at its various sessions, have well justified the hopes of those instrumental in its establishment. For this interest, the Executive Committee wishes to express its gratification and appreciation.

The Executive Committee has held three meetings during the Division year ending January 22, 1925, in Cleveland, Ohio, on February 24, 1924, in Detroit, Mich., on October 22, 1924, and in New York, N. Y., January 20, 1925. At these meetings arrangements for the programs of the Division's sessions, appointments of committees, suitable activities for the

Division, and other questions of policy have been studied and determined upon. Tentative arrangements have been made for consideration at the Cincinnati meeting of the subject of river pollution with particular reference to the investigations of the United States Public Health Service on the Ohio River, and at the Montreal meeting of some phase of the problem of garbage disposal. It now seems wise to omit the Division Session at the Salt Lake City meeting.

The Division itself has held four meetings: In New York on January 17, in Atlanta, Ga., on April 10, in Pasadena, Calif., on June 19, and in Detroit, Mich., on October 22 and 24. The meeting on October 22 was a Joint Meeting with the Sanitary Engineering Section of the American Public Health Association. At the time of the meeting of January 17, a joint luncheon was held with the New York Section of the American Water Works Association. Prior to the meeting in January, the Division held its Annual Dinner on January 15.

The programs of papers and discussions have appeared in the *Proceedings* of the Society and are repeated here for convenient reference only.

1924 Program

Annual Meeting, New York, N. Y.—

January 15, 1924, Annual Dinner at Hotel McAlpin; "Sanitation—Its Relation to Health and Life",* Address by the late George C. Whipple, M. Am. Soc. C. E.

January 17, 1924, "Distribution of Intense Rainfall and Some Other Factors in the Design of Storm-Water Drains",† by Frank A. Marston, M. Am. Soc. C. E.; and, "Imhoff Tanks—Reasons for Differences in Behavior",‡ by Harrison P. Eddy, M. Am. Soc. C. E.

Spring Meeting, Atlanta, Ga.—

April 10, 1924, "Municipal Water Supply Problems of Atlanta", by Paul H. Norcross, M. Am. Soc. C. E.; and, "Sewage and Water Treatment in the State of Georgia", by H. C. Woodfall, Esq., Chief Engineer, Georgia State Board of Health, Atlanta, Ga.

Annual Convention, Pasadena, Calif.—

June 19, 1924, "The Tri-Cities Sewage Disposal Plant for the Cities of Pasadena, South Pasadena, and Alhambra, Los Angeles County, California", by Robert Orbison, M. Am. Soc. C. E.; and "Sewage Disposal for the Los Angeles Metropolitan District", by Willis T. Knowlton, M. Am. Soc. C. E.

Fall Meeting, Detroit, Mich.—

October 22, 1924, Joint Session with Sanitary Engineering Section, American Public Health Association.

October 24, 1924, Illustrated Address on Recent Developments in English Sewage Treatment, by Robert L. Sackett, M. Am. Soc. C. E.; "Treatment of the Sewage of Chicago", by Langdon Pearse, M. Am. Soc. C. E.; Illustrated Address on Sewage Disposal Problems in the Detroit Area, by Clarence W. Hubbell, M. Am. Soc. C. E.; and Illustrated Address on Water Supply Problems in the Detroit Area, by George H. Fenkell, M. Am. Soc. C. E.

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* *Proceedings*, Am. Soc. C. E., April, 1924, Papers and Discussions, p. 490.

† *Transactions*, Am. Soc. C. E., Vol. LXXXVII (1924), p. 535.

‡ *Proceedings*, Am. Soc. C. E., May, 1924, Papers and Discussions, p. 616.

Committees

During the year, various Committees were appointed to deal with the following matters: International Conference of Sanitary Engineers in London; Co-Operation with the National Coast Anti-Pollution League; Definitions of Terms Used in Sewerage and Sewage Disposal; Friction of Sludge in Pipes; Co-Operation with New Jersey Agricultural Experiment Station and New Jersey Sewage Works Association; Design of the Rudolph Hering Medal; Nomination; Audit of Books of Division; and Arrangement for January dinner. As a matter of record, the membership of these Committees is listed as follows:

International Conference of Sanitary Engineers, London, England.—Messrs. T. C. Hatton, R. O. Wynne-Roberts, and G. Bertram Kershaw.

Committee to Co-Operate with National Coast Anti-Pollution League.—Messrs. C. A. Emerson, Jr., C. M. Saville, and E. S. Rankin.

Committee on Definitions.—Messrs. George C. Whipple, Paul Hansen, and Theodore Horton.

Committee on Friction of Sludge in Pipes.—Messrs. Glenn D. Holmes. Langdon Pearse, and C. E. Keefer.

Committee to Co-Operate with New Jersey Agricultural Experiment Station and New Jersey Sewerage Works Operators Association.—Mr. C. G. Wigley.

Committee on Design of the Rudolph Hering Medal.—Mr. S. A. Greeley.

Nominating Committee.—Messrs. W. W. DeBerard, G. B. Gascoigne, A. P. Folwell, C. G. Gillespie, and G. J. Requardt.

Audit Books of Division for 1923.—Messrs. Langdon Pearse, W. W. Horner, and H. P. Eddy.

January Dinner.—Mr. Kenneth Allen.

Financial

The budget allowance for the year was $1 000. On December 31, 1924, the end of the fiscal year, a balance of $74.55 remained, which was returned to the Society. A budget allowance of $1 200 has been requested for the ensuing year.

Co-Operation with Other Societies

One of the matters which has caused some concern and much consideration on the part of your Executive Committee is the overlapping of function and the duplication of effort on the part of various professional societies covering the field of Sanitary Engineering. It appears to this Committee that the Division should endeavor to bring about closer co-operation among the various Societies with a view of avoiding such overlapping and duplication in so far as is desirable and practicable. It has been suggested that the Executive Committee endeavor to secure such co-operation and co-ordination between different Societies as may be found feasible.

As the matter of overlapping may be of interest to other Divisions, as a proper solution may involve questions of Society policy, it is suggested that the matter be brought to the attention of the Board of Direction.

Suggestion for International Conference of Sanitary Engineers

The first International Conference of Sanitary Engineers held in London, England, in July, 1924, was attended by ten engineers from the United States. The success of this Conference leads to the conviction that such conferences should be held from time to time and that plans should be made for the next Conference to be held in the United States, probably in 1926. It is suggested that this Division take the initiative and appoint a committee with full authority to proceed with the arrangements to that end and that the committee be authorized to arrange for co-operation in this effort with other Societies which may be interested.

George Chandler Whipple

Before ending this report, it seems highly fitting to refer to the loss which the Division and the Sanitary Engineering Profession has sustained in the death of George Chandler Whipple, M. Am. Soc. C. E. This is not the place for an account of his notable achievements in many fields of sanitation. His breadth of vision, keen mind, and common sense are well known to all. His genial personality and kindly humor will be missed by all who knew him.

Harrison P. Eddy, *Chairman,*
W. W. Horner,
Kenneth Allen,
Langdon Pearse,
R. O. Wynne-Roberts,
Executive Committee

Progress Reports of Committees of Technical Divisions

Report of the Committee of the Sanitary Engineering Division on the International Conference on Sanitary Engineering held in London, England, 1924

An International Conference on Sanitary Engineering was held in London, England, from July 7 to July 10, 1924, inclusive. This Conference was instigated by The Institution of Sanitary Engineers of Great Britain—of which Mr. J. V. Alvord is President—which invited societies interested in Sanitary Engineering in several countries to co-operate.

Delegates from ten countries were in attendance, as follows: England, United States, Sweden, Holland, Scotland, India, Federated Malay States, Canada, France, and Russia, there being about 150 present, of whom 8 were from the United States.

The subjects on which papers were presented and quite thoroughly discussed were, as follows:

State Sanitary Administration
Works for the Prevention of Malaria and Yellow Fever
Methods of Disposal of Sewage and Trade Wastes in Various Countries
Treatment of Sludge Arising from the Agitation Processes of Sewage Disposal
Fertilizing Value of Sewage Sludge
Sewage and the Control of Storm Water
Design of Sedimentation Works
House Sanitation
Refuse Collection and Disposal
National Control of Water Sources
Water Precipitation

Of the papers presented ten were by delegates from England, eleven from the United States, one from France, one from Scotland, one from the Federated Malay States, five from Sweden, two from India, four from Holland, one from Canada, and one from Russia.

All the papers were short and to the point. Most of them were printed and distributed in advance of the Conference, thus enabling each delegate to become conversant with its contents before the paper was presented. This enabled time for full discussion, as the papers were not read in full, the writer being given the opportunity to brief his paper, which rarely occupied but a few minutes, after which discussion was encouraged by the Chair. This discussion in nearly every case brought out information which was quite as valuable as the subject-matter in the paper and was quite successful in establishing a freedom of expression so frequently absent in such technical gatherings; in fact there was an atmosphere of good fellowship throughout the whole Conference which every one seemed to appreciate, and which was largely due to the hospitable attitude of the officers of The Institution of Sanitary Engineers.

Each session of the Conference was presided over by a President or Past-President of the Institution and its genial Secretary was ever present to

render any service required. On Wednesday, July 9, a luncheon was given to the delegates and their wives, which was the only sociality extended, in fact, the sessions so fully occupied the time of the delegates that no opportunity was afforded for extraneous things.

While all papers presented had a significant value to those present, the outstanding interest was apparent in the papers relating to disposal of sewage and trade wastes, to sludge treatment, and to house sanitation. The largest attendance at any conference was on Tuesday, July 8, when the subject of Sewage Disposal was presented for discussion, and all nine papers dealt with some phase of the activated sludge process. Of these nine papers, seven were presented by delegates from the United States, one from India, and one from England.

In passing, it might not be amiss to state that the activated sludge process appears to have gripped the English sanitary engineer as no other process of sewage disposal has done, and he seemed to be anxious to know of the development made in the United States.

The Conference was quite successful in bringing together a body of technical men from many parts of the civilized world, all interested in the same subject. This personal contact was not only pleasant, but profitable, especially in demonstrating that community life everywhere has similar problems in sanitation to solve.

It was felt that in the near future when the European engineer has recovered from the depression following the World War it would be wise to hold another Conference fathered by the American Society of Civil Engineers or probably by the Sanitary Division of that Society.

In closing this report, it may be well to call your attention to the fact that the *Transactions* of the Conference are printed and ready for distribution. There are 100 copies available to those in the United States who desire them and their price is $2.50 per copy.

T. CHALKLEY HATTON,
Chairman.

Tentative Report of the Committee of the Sanitary Engineering Division on Definitions

In May, 1924, the undersigned were appointed a committee to consider definitions of terms used in connection with sewerage and sewage disposal, with the suggestion that the investigation be undertaken co-operatively with a corresponding committee of the Sanitary Engineering Section of the American Public Health Association.* The members of the two Committees have not met together, but the subject has been considered by correspondence. At Detroit, Mich., a joint meeting of the Sanitary Engineering Division of the Society and the Sanitary Engineering Section of the A. P. H. A. was held on October 22, 1924, at which time John F. Skinner, M. Am. Soc. C. E., presented

* John F. Skinner, *Chairman*, George B. Gascoigne, John H. Gregory, T. Chalkley Hatton, F. W. Mohlman, and W. L. Stevenson.

a tentative report of his Committee, which included definitions of terms based on the work of both Committees. There was no discussion of the report at that meeting.

In order to facilitate discussion and bring the matter to the attention of engineers interested in the subject, a list of definitions is herewith submitted. In preparing it, the Committee used as a basis the Report of the Committee on Sewerage and Sewage Disposal of the Sanitary Engineering Section, A. P. H. A., made on October 17, 1917. It is not as comprehensive as the list presented at Detroit and is arranged topically instead of alphabetically. Its tentative character is emphasized and, although most of the definitions are approved by all three members of this Committee, there are some on which difference of opinion still exists.

The Committee requests that members interested in the subject will communicate their opinions to the Chairman* of either Committee, in order that a revised list may be submitted for approval by the Joint Committee at a later date.

As to Definitions.—Certain words are used both in a popular and a technical sense. The Committee believes that its function is to establish the best technical definition. Although popular meanings are not to be ignored, it is for the interest of the Engineering Profession to limit the use of each term to a definite idea as far as this can be done.

The same word is sometimes used as a substantive, as a verbal noun, and as an adjective. For example, the word "Plumbing" may refer to the structures or to the act of installing structures, while in the expression, "Plumbing System", it is used as an adjective. In some cases, therefore, it may be necessary to give more than one definition of a word. As far as possible, however, this double or triple use of a word should be discouraged.

In studying the use of words numerous geographical differences have been brought to the attention of the Committee. Terms used in one part of the country seem to have a different significance from those used elsewhere. It is largely for this reason that it is important to have full discussion of the subject before standard definitions are adopted. The fact that some of the terms are defined in laws which cannot be easily changed also introduces complications. Correspondents are requested to keep these matters in mind in discussing the subject.

Arrangement of Definitions.—Although the topical method has been suggested and has been followed for the purpose of discussion, it is believed that when the definitions have been decided on, the final list should be issued in alphabetical order. The Committee will welcome a full and free discussion of the entire subject.

GEORGE C. WHIPPLE, *Chairman,*
THEODORE HORTON,
PAUL HANSEN.

November 19, 1924.

* Chairman George C. Whipple died November 27, 1924. Communications relative to this report may be addressed to Messrs. Horton and Hansen, or to Harrison P. Eddy, Chairman, Executive Comm., Sanitary Engineering Division of the Society.

DEFINITIONS

Sewage

Sewage.—Waste liquid usually containing human excreta and decomposing matter, flowing in or from a house drainage system or sewer. ("Excreta" includes feces, urine, secretions from skin, and expectorations.)

Domestic Sewage.—Sewage derived principally from dwellings, business buildings, institutions, and the like. (It may or may not contain ground-water, surface water, or storm water. It may also contain a small proportion of industrial waste.)

Industrial Waste Liquid.—Waste liquid resulting from processes used in manufacturing, industry, or trade.

Industrial Refuse.—Waste solids resulting from processes used in manufacturing, industry, or trade.

Industrial Sewage.—Industrial waste liquid which also contains human excreta. (There may be domestic sewage from a factory without mixture with industrial waste liquid; but this needs no special term. The distinction between domestic sewage containing industrial waste liquid and industrial sewage is one of degree rather than kind.)

Drain Water.—Rain-water or ground-water flowing in or from a drain, not containing human excreta or industrial waste.

Sink Waste.—Waste liquid in or flowing from a sink.

Surface Water.—Rain-water which remains on or flows over the surface of the ground.

Ground-Water.—Water remaining in or flowing through or from the ground.

Dry Weather Sewage.—Sewage of a combined system during dry weather without admixture of surface or storm water.

Storm Water Sewage.—Sewage of a combined system of sewers during or following a period of rainfall.

Storm Water.—Drain water during or following a period of rainfall.

Polluted Water.—Water fouled with sewage, industrial waste, or other liquid filth.

Contaminated Water.—Water unfit for domestic use because of the presence of sewage.

Infected Water.—Water which contains disease germs.

Scum.—A mass of sewage solids, buoyed up by entrained gas, grease, or other substances which floats at the surface of sewage.

Screenings.—The material removed from sewage by screens or racks.

Grit.—The heavy mineral matter deposited from sewage in grit chambers.

Detritus.—The heavy mineral matter deposited from sewage in detritus tanks.

Sleek.—The thin oily film present on the surface of water into which sewage has been discharged.

Sewerage and Drainage

Sewer.—A pipe or other conduit, usually underground, for conveying sewage, industrial waste liquid, or other liquid filth.

Drain.—A pipe or other conduit, usually underground, for carrying off by gravity any waste water or liquid other than sewage or industrial waste liquid.

Storm Water Drain.—A drain for carrying off surface or storm water, street wash, and the like, but not including sewage or industrial waste liquid.

Land Drain.—A drain for carrying off subsoil or ground-water.

Drainage.—A general term applied to any system of pipes operated by gravity flow. (This word should not be applied to a substance.)

Drainage System.—A system of connected pipes or drains for collecting and carrying off water or any liquids, except sewage and industrial waste, from a certain district.

House Drainage System.—That part of the plumbing system of a house which conveys sewage or waste water from the plumbing fixtures to a sewer or drain.

Sewerage System.—A system of connected sewers, with appurtenances, intended to operate together to serve a certain district.

Combined System of Sewers (*Combined Sewerage System*).—A system of sewers intended to receive both sewage and storm water.

Separate System of Sewers (*Separate Sewerage System*).—A system of sewers intended to receive sewage without the admixture of storm water.

Combined Sewer.—A sewer intended to receive both sewage and storm water.

Separate Sewer.—A sewer intended to receive sewage without the admixture of storm water.

Compound System.—The combination into a single system of separate sewers and combined sewers.

Common Sewer.—A sewer in which all abutters have rights.

Public Sewer.—A common sewer controlled by public authority.

Private Sewer.—A sewer privately owned and serving one or more properties.

House Sewer.—A pipe outside of a building which connects the house drain (the lower horizontal part) of a plumbing system with a common sewer or other place of disposal.

House Sewer Connection.—(Omit.)

Lateral Sewer.—A small sewer, usually serving one street, which receives sewage from individual sewers, but not from any other common sewer.

Branch Sewer.—A sewer which receives sewage from one or more lateral sewers and which discharges into a main or trunk sewer.

Sub-Main Sewer.—Same as *Branch Sewer.*

Main Sewer.—A sewer which receives sewage from one or more branch sewers as tributaries.

Trunk Sewer.—The main sewer of a large territory.

Outfall Sewer.—The sewer which conveys sewage from the collecting system to its place of final disposal.

Sewer Outfall.—The place where the sewage finally leaves a sewerage system.

Intercepting Sewer.—A sewer, commonly parallel to some body of water and transverse to the lateral or main sewers, intended to intercept the sewage of a separate system or a determined portion of the storm sewage of a combined system.

Relief Sewer.—A sewer built to supplement an old sewer of inadequate capacity.

Storm Overflow Sewer.—A sewer used to carry the excess of storm sewage from a main or intercepting sewer to an independent outlet.

Under-Drain, or Sub-Drain.—A drain built beneath a sewer to intercept ground-water and prevent it from entering the sewer, especially during construction.

Invert.—The inside bottom line of a sewer or drain.

Crown.—The inside top line of a sewer or drain.

Slope.—The inclination of the bottom of a sewer or drain, usually expressed as 1 ft. in so many feet, or as a percentage.

Hydraulic Gradient (*Hydraulic Inclination, Hydraulic Slope, Hydraulic Grade*).—The slope of the free surface of the water in a sewer or drain (often but not necessarily the same as the slope of the sewer).

Grade.—The elevation of the invert of a sewer or drain above some established datum.

Sub-Grade.—The elevation of the bottom of a trench in which a sewer or drain is laid.

Storm Overflow.—A weir, orifice, or other device for permitting the discharge from a combined sewer of that portion of the storm overflow in excess of that which the sewer is designed to carry.

Subsoil Drain.—A land drain deep enough to take water from the subsoil.

Inverted Siphon.—See *Depressed Sewer.*

Depressed Sewer (*Inverted Siphon or Drain*).—A portion of a sewer, depressed below its normal grade in order to pass beneath a watercourse or obstruction, running full and under pressure.

Sewer Appurtenances

Manhole.—A shaft, or chamber, from the surface of the ground to a sewer or drain, large enough to enable a man to have access for the purpose of inspection and cleaning.

Lamphole.—A small vertical pipe or shaft leading from the surface of the ground to a sewer for admitting a lantern or reflected light for purposes of inspection.

Drop Manhole.—A vertical shaft in which sewage is allowed to fall from a sewer at a higher level to a manhole from which a sewer at a lower level departs.

Inlet.—A connection between the surface of the ground and a combined sewer or drain for the admission of surface or storm water.

Catch-Basin.—A chamber beneath an inlet to prevent the admission of grit and other coarse material into a combined sewer or drain.

Flush-Tank.—A chamber or tank in which water or sewage is accumulated and discharged at intervals, for the purpose of flushing a sewer.

Regulator.—A device for controlling the quantity of sewage admitted to an intercepting sewer or unit of a disposal plant.

Grit-Catcher (*Sand Catcher*).—A chamber usually placed at the upper ends of an inverted siphon or other point of protection on combined sewers or drains of such shape and dimensions as to reduce the velocity of flow and thus permit the settling of sand, gravel, and the like.

Bellmouth.—A bell-shaped section of sewer used to facilitate flow into a sewer or between different sections of a sewer.

Alignment.—The direction in plan along which the axis of a sewer is laid.

Sewage Disposal

Sewage Disposal.—The act or method of disposing of sewage. (A general term.)

Sewage Treatment.—An artificial process or method applied to sewage to remove some or all of its impurities or so to alter them that the sewage is made less dangerous or offensive. (Preferable to the term, *Sewage Purification.*)

Sewage Purification.—Synonymous with *Sewage Treatment.* (An unsatisfactory term for the reason that sewage is seldom made "pure".)

Clarification.—The partial or complete removal of suspended or colloidal matter from a turbid liquid.

Screening.—The removal of relatively coarse suspended matter by straining through bars, meshes, or other fine or coarse openings.

Sedimentation.—The subsidence and deposition of suspended matter in a liquid brought about by gravity.

Filtration.—The process of removing suspended or colloidal matter from a liquid by causing it to flow through a relatively fine porous medium. (The liquid usually fills the pores of the medium.)

Percolation.—The downward flow or trickling of a liquid through a relatively coarse porous medium. (The liquid usually does not fill the pores of the medium.)

Chemical Precipitation.—Sedimentation accelerated by the use of a coagulating chemical.

Coagulation.—The flocculation of colloidal or suspended matter brought about by the addition of some chemical to the liquid.

Aeration.—The process or method of bringing about contact between air, water, or sewage, for the purpose of securing an absorption of oxygen by the water or a reduction of dissolved gases.

Activated Sludge Method.—A method of sewage treatment in which sewage standing in or flowing through a tank is brought into intimate contact with air and with biologically active sludge, previously produced by the same process, and subsequently clarified by sedimentation.

Bio-Aeration.—A modification of the activated sludge process, by which sludge contact and aeration are secured by mechanical means.

Disinfection.—The partial destruction, ordinarily by the use of some chemical, of micro-organisms and spores likely to cause infection and disease.

Sterilization.—The complete destruction of micro-organisms and their spores, ordinarily through the agency of heat, or of some chemical.

Putrefaction.—Decomposition of organic matter under conditions of oxygen deficiency.

Putrescibility.—The susceptibility of sewage, sewage effluents, foul liquids, or sludge, to putrefaction under the conditions to which it is subjected.

Stability.—The capability of sewage, sewage effluents, foul liquids, or sludge, to resist putrefaction under the conditions to which it is subjected. (The opposite of *Putrescibility.*)

Relative Stability.—The ratio of available oxygen in sewage effluent, foul liquids, or diluted sludge to the bio-chemical oxygen requirement, expressed in percentage.

Bio-Chemical Oxygen Requirement.—The quantity of oxygen required by the living organisms present to prevent the putrefaction of sewage, sewage effluents, or foul liquids.

Cesspool.—A pit into which household sewage or other liquid filth is discharged and out of which the liquid leaches into the surrounding soil or is otherwise removed.

Leaching Cesspol.—A cesspool so constructed that the liquid may leach into the surrounding soil.

Water-Tight Cesspool.—A cesspool built with tight walls to prevent leaching and from which the contents are removed at intervals.

Basin.—A shallow tank through which sewage passes or is detained for treatment.

Tank.—A chamber through which sewage passes or in which it is detained during its collection or treatment.

Chamber.—A general term for a space enclosed by walls.

Screen.—A device consisting of bars, mesh, or perforated plate used to remove particles of suspended matter larger than the openings.

Coarse Screen.—A screen having openings 1 in., or more, in least dimension.

Fine Screen.—A screen having openings less than ¼ in. in least dimension.

Medium Screen.—A screen having openings intermediate between those of a coarse and a fine screen.

Bar Screen.—A screen composed of parallel bars or rods.

Mesh Screen.—A screen composed of bars, rods, or wires running in two directions.

Plate Screen.—A screen composed of a plate perforated with round holes, long narrow slots, or other openings.

Band Screen.—A screen consisting of an endless band or belt of wire mesh or other screen material which passes around upper and lower rollers.

Drum Screen.—A screen in the form of a cylinder or cone, consisting of perforated plates or wire mesh, which rotates on an approximately horizontal axis.

Disc Screen.—A screen consisting of a rotating circular perforated disc, with or without a concentric truncated cone of similar material and usually slightly inclined to its horizontal.

Cage Screen.—A screen consisting of a cage, with bottom and three sides of parallel bars or rods, so arranged that it may be lowered into the sewage and raised therefrom for cleaning.

Wing Screen.—A screen having radial or curved vanes which rotate on a horizontal axis.

Grit-Chamber.—A small retention chamber or enlargement of a sewer designed to check the velocity of the sewage enough to permit the heaviest solid matter, such as grit and sand, to be deposited with a view to its frequent and easy removal.

Detritus Tank.—A retention chamber larger than a grit-chamber, usually with provision for removing the sediment without interrupting the flow of sewage.

Sedimentation Basin or Tank.—A tank or basin in which the sewage is retained long enough, and in which the velocity is low enough, to bring about sedimentation of a part of the suspended matter, but without sufficient detention period to produce anærobic decomposition.

Settling Chamber.—The second, or final, element of the biolytic process of sewage treatment.

Septic Tank.—A settling tank intended to retain sewage long enough to allow anærobic bacterial decomposition of the sewage sludge to occur.

Horizontal Flow Tank.—A sedimentation tank or basin, with or without baffles, in which the direction of the flow is horizontal and lengthwise.

Vertical Flow Tank.—A settling tank, generally circular or square in plan, in which the sewage enters near the bottom and flows out near the top, the prevailing direction of flow being vertically upward.

Dortmund Tank.—A particular type of vertical flow tank, deep, cylindrical, and with a conical or hopper-shaped bottom, with provision for drawing off the sludge without emptying the tank.

Radial Flow Tank.—A circular tank so designed that sewage enters near the center and leaves near the periphery, the prevailing direction of flow being radially outward and horizontal.

Imhoff Tank (Emscher Tank).—A tank or basin having an upper and a lower compartment separated by steeply inclined partition walls so arranged that when sewage passes horizontally across the upper compartment, suspended matter may settle through trapped slots into the lower compartment, where, with no contact with the sewage above, but with vents provided for the escape of gas, opportunity is given for septic action and provision is made for drawing off the decomposed sludge.

Digestion Tank.—A tank or basin into which sludge from a sedimentation tank is put for the purpose of allowing digestion by septic action to occur.

Sludge Disposal

Sludge.—The accumulated suspended solids of sewage deposited in tanks or basins, mixed with more or less water to form a semi-liquid mass.

Sludge Digestion.—The bio-chemical process by which organic matter in sludge is gasified, liquefied, mineralized, or converted into more stable organic matter.

Separate Sludge Digestion.—The digestion of sludge in basins or tanks to which it is removed from the basins or tanks in which it originally settled.

Sludge Drying Beds.—Natural or artificial layers of porous material on which sludge is dried by drainage and evaporation.

Sludge Concentration.—Any process of reducing the water content of sludge which leaves it still in a liquid condition.

Sludge Drying.—The process of drying sludge by drainage or evaporation, by exposure to the air or the application of heat.

Sludge Dewatered.—Any process of removing a portion of the water contained in the sludge by draining, pressing, centrifuging, heating, or other chemical or mechanical process.

Sludge Pressing.—The process of dewatering sludge by subjecting it to pressure, the solids being retained by a cloth fabric, the water passing through it.

Commercially Dry Sludge.—Sludge containing not more than 10% water.

Liquid Sludge.—Sludge containing water enough to permit it to flow by gravity (ordinarily more than 80 per cent.).

Sludge Paste.—Sludge containing more than enough water to fill the void spaces, but not enough to permit it to flow by gravity (ordinarily between 35 and 75 per cent.).

Sludge Cake.—Sludge containing not enough water to fill the void spaces (ordinarily less than 35 per cent.).

Suspended Matter.—

Settleable Solids.—Suspended matter which will settle within a reasonable period of sedimentation.

Non-Settleable Solids.—

Miscellaneous

Sewage Oxidation.—The process whereby through the agency of living organisms in the presence of air, the organic matter is converted into a more stable form or into mineral matter.

Sewage Irrigation.—The process of sewage disposal in which the sewage is applied to land for the primary purpose of purifying the sewage and the secondary purposes of supplying water and fertilizer to crops.

Surface Irrigation.—The process of sewage irrigation in which sewage is applied to and distributed over the surface of the ground.

Sub-Surface Irrigation.—The process of sewage disposal in which sewage or tank effluent is distributed beneath the surface of the ground by means of open-jointed pipes.

Intermittent Sand Filter.—A natural or artificial bed of sand or other fine-grained material to which sewage is intermittently applied in doses and through which it flows, opportunity being given for filtration and oxidation of the organic matter by the bio-chemical agencies.

Contact Bed.—A water-tight basin filled with coarse, porous material provided with controlled inlet and outlet, used for treating sewage and operated in cycles of filling, standing full, emptying, and resting empty in order to remove a part of the suspended matter and oxidize a part of the organic matter by bio-chemical agencies.

Slate Bed.—A type of contact bed in which slates or other flat plates, laid horizontally and separated from each other by proper supports, take the place of coarse porous material.

Trickling Filter.—An artificial bed of coarse aggregates over which the sewage is distributed as a spray from fixed nozzles or as a film from moving distributors and through which it trickles to the under-drain system, giving opportunity for the bacteria to be removed and for the organic matter to be oxidized by the bio-chemical agencies.

Sprinkling Filter.—See *Trickling Filter.*

Percolating Filter.—See *Trickling Filter.*

Dosing Tank.—A tank into which raw or partly treated sewage is introduced and held until the desired quantity has been accumulated, after which it is discharged at such a rate as may be necessary for distribution essential to the subsequent treatment.

Sprinkler Nozzle.—A nozzle used for applying sewage in the form of a spray to a trickling filter.

Distributor.—A movable perforated pipe, channel, or water-wheel which distributes sewage upon the surface of a trickling filter. (There are two types of distributors, the rotary and the traveling; the rotary distributor moves about a central axis with delivery to a circular filter; the traveling distributor moves back and forth the length of a rectangular filter.)

Report of Special Committee of the Sanitary Engineering Division Relating to the New Jersey Sewage Experiment Station

To the Members of the Sanitary Engineering Division,
American Society of Civil Engineers:

The investigators of the New Jersey State Sewage Experiment Station, in the introduction to the Annual Report for the year ending June 30, 1924, state that, knowing bacteria, protozoa, and microscopic plants to be present and performing some function in sewage treatment plants, no true picture can be constructed of the activities taking place during the processes of digestion, stabilization, or so-called purification of sewage, so long as the interdependence of these various agents and the resulting chemical changes due to their activities are not correlated. They further indicate that very little is known of the physico-chemical factors involved, or of the effects of organic acids produced during the processes of digestion on the flora and fauna of the sewage.

These considerations have up to the present been the basis for their investigations and of others in various parts of the country who have become interested in the making of co-operative studies with them.

The Staff of the Experiment Station consists of a Research Chemist, Bacteriologist, Zoologist, Botanist, and Assistants under the direct supervision of a Chief of Sewage Investigation, some of the staff being employed on a part-time basis.

The program for future work is extensive and should aid the Sanitary Engineer greatly in his work by supplying much valuable data in the chemistry, bacteriology, zoology, and botany of sewage treatment works.

During the year several papers relating to various studies have been published. The titles and references to these papers are appended.

The report itself comprises about 100 typewritten pages, 18 tables, and about 40 charts.

In the Introduction occurs this sentence: "Enormous quantities of materials which could be used profitably as fertilizers are wasted." It is perhaps unfortunately stated and probably is intended to mean that the fertilizing material in sewage could be used advantageously if means could be found to

recover it profitably, *i. e.*, at a cost somewhat less than the present cost of other fertilizers now used.

Investigations were made for the purpose of acquiring a more exact knowledge of sludge digestion. The nature of tests and sampling is described in detail. Practically all observations and determinations made on the resting and operating tanks point to a rise and then a fall in digestive activity during the course of the test. Detailed discussions are given on the behavior of the tanks and gas production, CO_2 and CH_4 percentage of the gas, solids, ash, carbonates, total acidity, ammonia nitrogen, influence of temperature, and PH values.

High amounts of ammonia corresponded with low percentage of CO_2 production, except in the cases during and shortly after sludge was drawn, when the ammonia produced had not yet a chance to accumulate. Carbonate reached the highest peaks shortly after CO_2 and NH_3-N was high. Total acidity did not coincide with the greatest CO_2 production. A comparison of PH values with CO_2 content shows a general inverse relation. It seems that hydrogen-ion concentration gives a true index of the total activities taking place in the tank. Foaming phenomena occurred when the PH values of the "liquid" between scum and sludge were below 7.0, and foaming subsides when the hydrogen-ion concentration is above the neutral point.

Bacteriological Work.—The survey of the bacteria flora which was begun in November, 1922, was continued until November, 1923. Attempts were made to determine the degree to which certain physiological activities occur. In this connection, some studies were made of the digestion of proteins, the reduction of sulphur compounds, and the relation or occurrence of soil bacteria were noted. One interesting phase of the investigation was that bacteria which produce nitrites and nitrate and those which oxidize sulphur compounds, were found throughout the plant, even in the Imhoff tank digestion chamber. Bacteria able to digest cellulose were also found throughout the plant, but never in large numbers.

In the study of bacteria of a single Imhoff tank, and calling the total number of bacteria in samples from influent, liquid, sludge, and scum, 100%, it would appear from a chart of the results for each of these parts of the tanks that the scum contained the greater number of bacteria per unit of volume with the next greatest number in the liquid in the tank. The relation between bacterial counts in these two portions of the contents of the tank are shown to bear an almost direct inverse proportion, for, as the count in one increased, the other decreased, and *vice versa.*

As the studies were made in Inhoff tanks known to be considerably overloaded and subject to frequent foaming, and as more recent designs with more liberal design of sludge compartments appear to have practically eliminated foaming, it is suggested by your Committee that comparable studies be made by the Experiment Station on Imhoff tanks operating under satisfactory conditions.

Studies of Fauna and Flora of Imhoff Tanks and Sprinkling Filters.—A list of organisms found in the Imhoff tank includes three *Sarcodina,* seven

Mastigophora, and five *Infusoria* of common occurrence, and those forms which are constantly found are noted. There are several interesting charts showing the numbers of several classes of protozoa as related to the depth of the liquid.

In the sprinkling filter the studies of previous years have been continued and valuable data and curves are given showing the rise, decline, and succession of various organisms. The conclusion is reached that the ciliates are the dominant group of organisms in the sprinkling filter, some occurring in succession, while the ciliate opercularia is found in largest numbers during winter months and is usually found in numbers equivalent to all the other ciliates.

Digestion of Fresh Solids.—Laboratory experiments were conducted relative to the digestion of sewage solids as in a tank, and from them it would appear that the hydrogen-ion concentration fluctuates with the carbon dioxide, and that there is a relation between the numbers of bacteria and microscopic animals.

Fungi and Algæ in the Sprinkling Filter.—The principal conclusions reached as to fungi were that in a sprinkling filter there is a seasonal variation, the maximum number being found during the winter. A study of one fungus tentatively identified as *Oidium* was made.

The studies of the Experiment Station for the year will be found interesting by any sanitary engineer. Some of the charts, however, could advantageously be supplemented with notes.

Furthermore, it is to be hoped that the Experiment Station will soon find it possible to construct some model experimental units and also extend its investigations to some properly functioning Imhoff tanks.

Respectfully submitted,

C. G. WIGLEY.

APPENDIX

PUBLICATIONS

The following papers have been published during the last fiscal year from the Sewage Substation:

Hotchkiss, Margaret. A Survey of Bacterial Activities in a Sewage Disposal Plant during One Year. Abstracts of Bact., v. 8, January, 1924, p. 12.

Rudolfs, Willem. Recent Developments in the Study of Sewage Disposal. *Public Health News,* v. 8, 1923, pp. 610-613.

Rudolfs, Willem, *et al.* Studies on the Biology of Sewage Disposal. *Bulletin 390,* New Jersey Agricultural Experiment Station.

Campbell, F. Leslie, and Willem Rudolfs. Studies on the Chemical Changes Occurring in a Sprinkling Filter. *American Journal of Public Health,* v. 14, 1924, pp. 398-401.

Hotchkiss, Margaret. Studies on the Biology of Sewage Disposal: A Survey of the Bacteriological Flora of a Sewage Treatment Plant. *American Journal of Bacteriology,* v. 9, 1924, pp. 437-454.

Hotchkiss, Margaret. Studies on the Biology of Sewage Disposal: A Sprinkling Filter Bed and Its Bacteriological Population. *American Journal of Bacteriology,* v. 9, 1924, pp. 455-461.

Rudolfs, Willem. Microscopic Plants Found in a Sewage Sprinkling Filter. *Public Health News,* v. 9, 1924, pp. 138-140.

Rudolfs, Willem. Organization and Program of the Sewage Substation and Some Results Obtained. *Proceedings,* Am. Water Works Assoc., 1924 (in press); also, *Engineering and Contracting* (Water-Works), v. 61, 1924, pp. 1301-1304.

Rudolfs, Willem. Some Sewage Experimental Work Accomplished and Under Investigation at the Sewage Substation during 1923. *Proceedings,* New Jersey Sewage Works Assoc., 1924; also, *Canadian Engineering,* Vol. 47, pp. 179-181.

Rudolfs, Willem, and F. Leslie Campbell. Variation in Gas Production in Imhoff Tanks. *Canadian Engineering,* v. 45, 1924, pp. 329-331.

In co-operation with the Department of Bacteriology of Rutgers College:

Gaub, William, Jr. A Bacteriological Study of a Sewage Disposal Plant. *Bulletin 394,* New Jersey Agricultural Experiment Station.

Progress Reports of Special Committees of the Society

Progress Report of the Special Committee on Impact in Highway Bridges*

TO THE AMERICAN SOCIETY OF CIVIL ENGINEERS:

The Committee has held two meetings during 1924, one at Chicago, Ill., on April 17, and the other at Ames, Iowa, on September 15.

The purchase, recommended in the Progress Report† presented to the Annual Meeting in 1924, of a twelve-element electrical remote-reading and recording extensometer, was approved by the Board of Direction and the instrument has been provided. Through the courtesy of the U. S. Bureau of Standards, the instrument was re-designed by the engineers of the Bureau, and constructed in its shops by its regular mechanics who were granted temporary leaves of absence and paid directly by the Society. The total cost of labor and materials was $3 037.45. The Bureau contributed the results of previous development work and the supervision of the manufacture, adjustment, and calibration.

The instrument was assigned, for 1924, to the one project which was known to be active in highway bridge impact investigations, the co-operative project at Ames, Iowa, between the U. S. Bureau of Public Roads, the Iowa Highway Commission, and the Engineering Experiment Station of Iowa State College. It was used on that project in determining static and dynamic stresses (therefore impact) on the stringers of a 24-ft. roadway, 26-ft. span, I-beam bridge, with 8-in. concrete floor, which was constructed on the campus of Iowa State College for experimental purposes. In order to insure the correct use of the instrument, the U. S. Bureau of Standards arranged for a temporary leave of absence of two of its engineers so that they could be engaged by the co-operating interests for the operation of the instrument. In this connection, Mr. O. S. Peters, one of the designers of the instrument, was available for two weeks, and Mr. F. A. Snell for the entire season. The instrument is constructed so that all the results from the twelve points of attachments may be photographed on one roll of 12-in. paper, or read immediately and independently on a panel ammeter. The results have justified the high expectations. All expenses of use were borne by the co-operating interests.

In the Progress Report presented to the Annual Meeting in 1924, was given an outline of the only known work in 1923. The results for 1923 have since been published by one of the co-operating interests.‡ Condensed conclusions were given as follows:

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* Presented to the Annual Meeting, January 21, 1925.

† *Proceedings*, Am. Soc. C. E., March, 1924, Society Affairs, p. 260.

‡ *Public Roads*, September, 1924, p. 10.

"Probable percentages to be added to static load stresses to allow for impact are given, as follows:

"For stringers: Clean floor, 12 per cent.; 1-inch obstruction, 40 per cent.; 2-inch obstruction, 80 per cent.

"For floor-beams: Clean floor, 10 per cent.; 1-inch obstruction, 40 per cent.; 2-inch obstruction, 57 per cent.

"For hip verticals: Clean floor, 25 per cent.; 1-inch obstruction, 90 per cent.; 2-inch obstruction, 150 per cent.

"Similar percentages for main truss members are also given in the detailed tables accompanying the report. They are omitted above not because the results do not command confidence, but because they are few in number and because the unit stresses are so small that they are not representative of fully loaded stresses."

The program arranged for the season of 1924 was to extend the work on floors to a general application. In order to reach general conclusions concerning the impact produced on different types of bridge floors by all kinds of loads, tires, chains, speeds, etc., it seemed desirable to direct the investigation so as to make use of the determination of impact on roads by the U. S. Bureau of Public Roads,* the Illinois Highway Department,† and any other which may be available.

Previous work has indicated that for floors of usual dimensions greater impact was produced by one hard blow of the heavy wheels than by accumulative vibration as has been demonstrated for railway bridge trusses. Therefore, the problem was approached by endeavoring to establish a relation between the intensity of the blow and the resultant impact. The intensity of the blow has been measured by "accelerometers" attached to the rear axles of the trucks. The accelerometers have been calibrated by means of "Kreuger cells" and static and dynamic testing machines and used in connection with the Society's electric extensometer and extensometers of other types.

The results of the season's work are not available in detail. It is evident, however, that although substantial progress has been made, further field work will be necessary. It seems possible to complete the field work in Iowa in the early part of the summer of 1925 and to supplement it by meeting a request (one has already been received) to transfer the equipment to another State. The Committee hopes to submit a Final Report on Impact in Highway Bridge Floors to the Annual Meeting in 1926.

The small amount of data which has been secured concerning impact in highway bridge trusses, suggests that an extension of the work to structures on traveled highways will be of doubtful value or at least decidedly uneconomical. It does not seem practicable to secure a live load which produces stresses of sufficient magnitude to be at all representative of specified conditions.

* "Researches on the Structural Design of Highways by the United States Bureau of Public Roads," by A. T. Goldbeck, Assoc. M. Am. Soc. C. E., *Proceedings*, Am. Soc. C. E., April, 1924, Papers and Discussions, p. 453, and *Public Roads*, March and December, 1921.

† "Highway Research in Illinois", by Clifford Older, M. Am. Soc. C. E., *Proceedings*, Am. Soc. C. E., February, 1924, Papers and Discussion, p. 175.

In anticipation of a possible extension of the work to include a worth while investigation of trusses, the Committee, in March, 1924, recommended to the Research Committee of the Society that steps be taken toward possible solicitation of funds or material to provide a truss span elsewhere than on a traveled highway. The summer of 1926 will apparently be the earliest time for beginning a truss project, even if one is authorized. In the meantime, the Committee would welcome suggestions from individuals and instructions from the Board of Direction.

Respectfully submitted,

A. H. FULLER, *Chairman,*
A. R. EITZEN,
E. F. KELLEY,
F. E. TURNEAURE.

December 19, 1924.

Progress Report of the Special Committee on Concrete and Reinforced Concrete Arches*

To the Board of Direction,
American Society of Civil Engineers:

The Special Committee on Concrete and Reinforced Concrete Arches begs leave to submit the following Progress Report.

Attention is called to the Progress Report of the Committee for 1923.† In this report the scope of the activities of the Committee was outlined, and the work started at Danville, Ill., and at Conneaut, Ohio, was described.

Receipts and Expenditures.—During the past year the work of the Committee has been retarded by lack of funds, and had it not been for the generous assistance of the Ohio State Highway Department and the University of Illinois Engineering Experiment Station, little progress would have been made. Engineering Foundation provided a fund of $3 000 which has been expended as follows:

1.—Special apparatus and materials to be used in experimental work for the Committee at the University of Illinois Engineering Experiment Station.
2.—Incidental expenses in connection with the investigations at Danville, Ill., and Conneaut, Ohio.
3.—Ten precise level bars for determining pier movements.
4.—Miscellaneous clerical and traveling expenses incidental to the work of the Committee.
5.—Expenses for one meeting of the Committee at the U. S. Bureau of Standards in Washington, D. C.

The distribution of these expenses may be obtained from the Secretary of the Society.

Third Meeting of the Committee.—By correspondence with the Director of the U. S. Bureau of Standards an effort was made to enlist the aid of the Bureau in the work of the Committee, and at the invitation of the Bureau, the Committee met there on September 25 and 26, 1924.

At this meeting the Bureau of Standards was requested to institute an investigation of the "flow" or "time yield" of concrete under stress, and to assign a full-time man to the investigation of movements and strains in a multiple-arch bridge under construction. It was also voted to request the U. S. Department of Commerce to construct and make a complete test of an experimental arch system in which the variables could be controlled.

At this meeting of the Committee, W. M. Wilson, M. Am. Soc. C. E., Research Professor of Structural Engineering, University of Illinois, was requested to undertake two special laboratory investigations:

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* Presented to the Annual Meeting, January 21, 1925.
† *Proceedings*, Am. Soc. C. E., March, 1924, Society Affairs, p. 290.

(1) The effect of "slenderness ratio" on the strength of unsupported arch ribs; and
(2) The expansion and contraction of reinforced concrete due to temperature changes and changes in moisture content.

The latter investigation might be thought to be a duplication of work already done by other experimenters, but in view of some rather surprising results obtained in the work of the Committee at Conneaut, Ohio, the laboratory tests were thought advisable in connection with a search into the literature of the subject.

Pier Movements.—At both the Danville and the Conneaut bridges, evidences of very definite movements of piers have been observed, and the Committee deems it very important that more information relative to the magnitude and effect of pier movements be obtained. Both the bridges mentioned are founded on rock, and the pier movements of bridges on less secure foundations must be of much greater magnitude, therefore, the Committee, at its Washington meeting, authorized the purchase of ten precise level bars which it expects to loan to engineers in various parts of the United States, who are willing to co-operate with the Committee in making observations as to pier movements.

Conneaut Viaduct.—A description of the bridge at Conneaut, Ohio, on which observations have been made for the Committee, was printed in the Progress Report of the Committee for 1923, referred to previously.

The following observations have been in progress for the past year:

1.—Apparatus was installed for measuring the yielding of the foundations under both sides of one pier, and observations were taken at various stages of the pouring operations.

2.—Strain-gauge points were set on two adjacent spans, along the neutral axis, and around the arch ring at the springing line and at the crown, for measuring deformations, and readings were taken at various construction stages.

3.—Strain-gauge points for measuring the deformations of the pier mentioned under Item (1) were set, and readings taken at various construction stages.

4.—Holes for internal temperature readings were provided at the springing line and crown of the two adjacent spans and records of temperature changes therein have been made.

5.—A duplicate of the crown section of the arch rib, 6 ft. long, was cast at the same time the arch was poured, on supports near the ground, and all measurements and readings on the crown section were repeated on the test specimen, which is free from stresses due to arch action.

6.—Readings of the movement of the top of the same pier on which the other observations were made, were taken with a large theodolite set upon a concrete base in a small house built for the purpose.

7.—Steel three-hinged arch centers with a tie-rod at the springing line were used for falsework, and strain-gauge readings on the members were taken in an effort to determine the loads and reactions.

The bridge at Conneaut was completed and opened to traffic on July 18, 1924. Provision has been made by the Committee for continuing observations of movements and strains due to climatic changes as listed in Items (1) to (5), during 1925. This is necessary in order to determine what part of the observations already made is due to construction operations and what part to climatic changes. The observations on the test block described in Item (5), indicate that the expansion and contraction due to climatic changes are less than is ordinarily assumed in arch calculations, and this led the Committee to institute the laboratory investigation of the subject. This work was under the general supervision of Clyde T. Morris, M. Am. Soc. C. E., Professor of Structural Engineering, Ohio State University, and in immediate charge of J. R. Burkey, Resident Engineer for the State.

Danville Bridge.—The Gilbert Street Bridge at Danville, Ill., is a reinforced concrete highway bridge consisting of six arch spans, having a combined length of 884 ft. 10½ in., and seven girder approach spans having a combined length of 153 ft. 6 in., making a total length for the entire structure of 1 038 ft. 4½ in. Each arch span consists of two ribs and a reinforced concrete deck supported on spandrel columns, as shown in Fig. 1. The bridge was designed by the firm of Harrington, Howard and Ash, and has been in service about three years.

Observations are being made on this bridge to determine the effect of climatic changes on a structure of this character. Most of the observations are being taken on Span No. 2 (see Fig. 1). The data being collected include the rise and fall of points on the arch rib ($N1$-$N6$ and $S6$-$S1$); rotation of points on the rib ($N1$-$N6$ and $S6$-$S1$); temperature of the rib; tipping of the piers; and the strain in the steel and concrete on Sections 1, 2, 3, 4, and 5. In addition to the observations listed for Span No. 2, the rotation of Piers Nos. 1, 5, and 6, and the change in width of the expansion joints, Nos. 1 to 26, are being noted. Readings were begun in November, 1923, and are repeated about once a month, and will continue until the summer of 1925. This work is being done by Professor W. M. Wilson, and his assistants.

Slenderness Ratio.—Tests are being made to determine the effect of the ratio of the width of an arch rib to its unsupported length, on the strength of the rib. The initial series consists of five reinforced concrete ribs that will be identical except for width, the widths being 4, 8, 12, 16, and 20 in., respectively. All ribs will have a rise of 4 ft. 6 in. and a span of 19 ft. 3 in. This work is being done at the University of Illinois, under the supervision of Professor Wilson. The detail work is being done by Mr. Cyrus Fishburn, a graduate student in Civil Engineering.

Expansion and Contraction.—Laboratory tests have demonstrated that concrete expands with a rise in temperature and with an increase in moisture content. The expansion and changes in temperature of the test block at the Conneaut Bridge described, indicate that the expansion and contraction have been less than the changes in temperature would lead the Committee to expect. It has been suggested that the expansion (or contraction) that would nor-

mally accompany a change in temperature has been partly balanced by a contraction (or expansion) due to a change in the moisture content of the concrete. This explanation seems plausible, inasmuch as concrete normally dries during the summer and absorbs moisture during the winter. The Committee, therefore, decided on a series of tests to determine the simultaneous changes in temperature and moisture content, and the resulting expansion and contraction of blocks of concrete which approximate in size of cross-section that of the rib of a concrete arch. These tests are being conducted at the University of Illinois under the supervision of Professor Wilson. The detail work is being done by Mr. I. O. Jahlstrom, a graduate student in Civil Engineering.

Observations are also being made on the bridge at Danville to determine the expansion and contraction of the concrete in a horizontal direction normal to the plane of the rib. These observations are being taken at nine points on the west rib of Span No. 2.

Skew Arches.—At the second meeting of the Committee, held at Conneaut, Ohio, in September, 1923, an investigation of the possibility of a mathematical analysis of the stresses in skew arches was discussed, as is noted in the Progress Report of the Committee for 1923, and this topic was assigned to E. H. Harder, Assoc. M. Am. Soc. C. E., for further study. It was with much interest and pleasure, therefore, that the Committee received the paper of J. Charles Rathbun, M. Am. Soc. C. E., entitled "Analysis of the Stresses in the Ring of a Concrete Skew Arch".* Mr. Harder's discussion of Professor Rathbun's paper has also been published.†

In the meantime, at the suggestion of the Committee, George E. Beggs, Assoc. M. Am. Soc. C. E., Associate Professor of Civil Engineering, Princeton University, had started plans for an experimental laboratory investigation of the same subject; and at its last meeting in Washington, the Committee visited the Laboratory of the U. S. Bureau of Public Roads where similar laboratory experiments on skew arches are being conducted. It is hoped that, from these varied sources, a satisfactory method of design may be evolved.

Multiple-Arch Systems.—At the second meeting of the Committee, held in Conneaut, Ohio, in September, 1923, A. C. Janni, M. Am. Soc. C. E., was asked to prepare a mathematical analysis to determine the effect of the elasticity of piers and the movement of foundations on the stress distribution in a multiple-span arch bridge. Mr. Janni's paper, "The Design of a Multiple-Arch System and Permissible Simplifications", has been published by the Society.‡ It is hoped that this, in connection with the experimental work being undertaken by the Committee, will furnish a rational basis for the design of multiple-arch systems on elastic supports.

Co-Operation.—Numerous offers of co-operation in the work of the Committee have been received from engineers in all parts of the country. As fast as conditions warrant, these offers are being accepted. Already several of the level bars referred to in a previous paragraph, have been sent to

* *Transactions*, Am. Soc. C. E., Vol. LXXXVII (1924), p. 611.
† *Loc. cit.*, p. 660.
‡ *Proceedings*, Am. Soc. C. E., August, 1924, Papers and Discussions, p. 755.

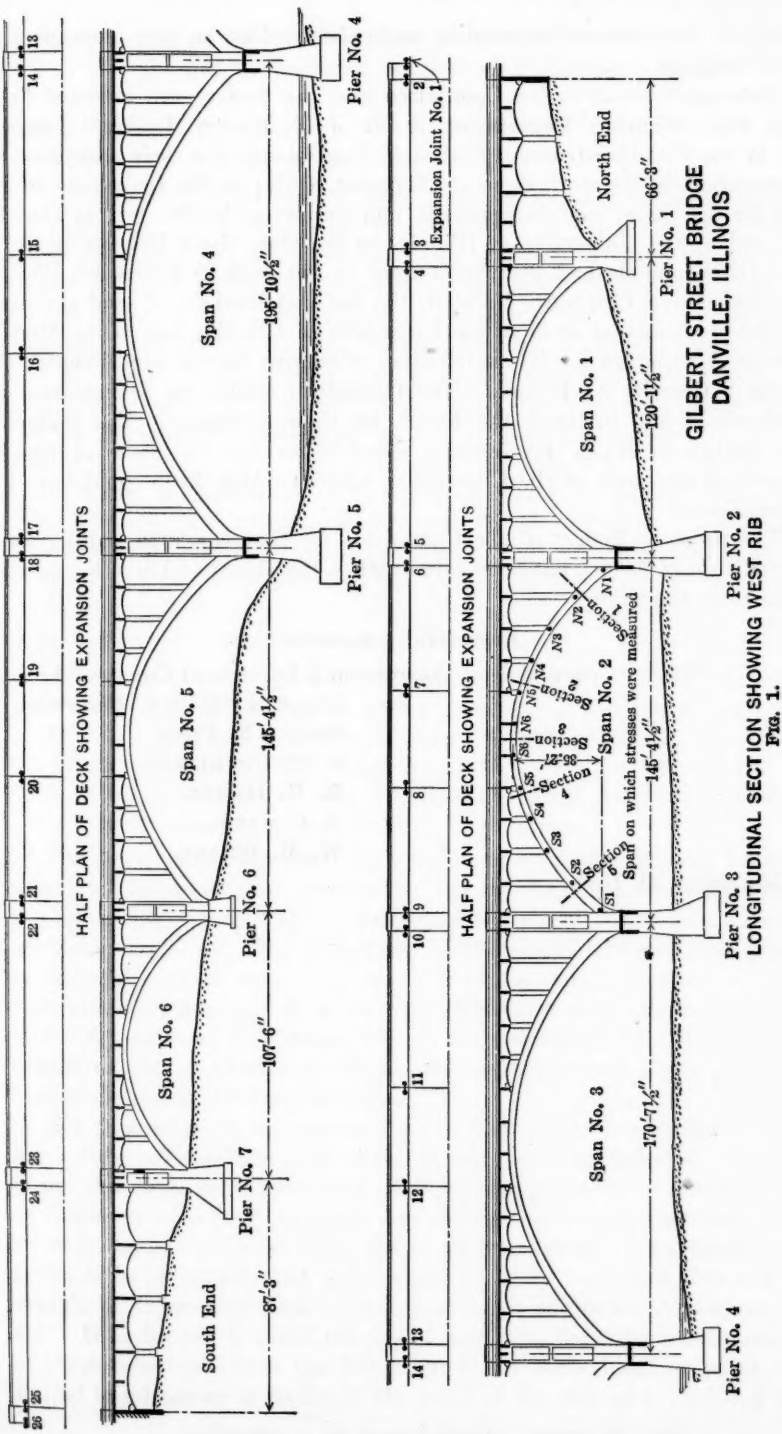
HALF PLAN OF DECK SHOWING EXPANSION JOINTS
Span No. 4
196'-10½"
Pier No. 4
Pier No. 5
Span No. 5
145'-4½"
Pier No. 6
Span No. 6
107'-6"
Pier No. 7
South End
87'-3"
Expansion Joint No. 1
HALF PLAN OF DECK SHOWING EXPANSION JOINTS
North End
Pier No. 1
66'-3"
Span No. 1
120'-1½"
Pier No. 2
Section 1
Section 2
Section 3
Section 4
Span No. 2
145'-4½"
Pier No. 3
Span on which stresses were measured
Span No. 3
170'-7½"
Pier No. 4
GILBERT STREET BRIDGE
DANVILLE, ILLINOIS
LONGITUDINAL SECTION SHOWING WEST RIB

FIG. 1.

engineers who have volunteered to make observations on pier movements for the Committee.

Acknowledgments.—The Committee and the Society are indebted to the Ohio State Highway Department, to Mr. J. R. Burkey, Resident Engineer, and to the Pitt Construction Company, Contractors, for their assistance and co-operation in the work done at Conneaut, Ohio; to the University of Illinois for the use of men, instruments, and equipment in the work at Danville, Ill., and at the University of Illinois; to the Ohio State University for the use of instruments and equipment used in the work at Conneaut, Ohio; to the Neal Gravel Company, Mattoon, Ill., for contributions of sand and gravel for the experimental work at the University of Illinois; and to the Portland Cement Association for its contribution of cement for the experimental work at the University of Illinois. The Committee wishes to acknowledge this indebtedness and to thank the donors for their assistance. The Committee also wishes to thank Engineering Foundation for its generous financial support of the work of the Committee, without which little could have been accomplished.

The proposed budget of the Committee for the year 1925, calling for an expenditure of $5 000, has been submitted to the Board of Direction in a previous communication.

Respectfully submitted,

Special Committee on Concrete and Reinforced Concrete Arches,
CLYDE T. MORRIS, *Chairman,*
GEORGE E. BEGGS,
J. R. CHAMBERLIN,
E. H. HARDER,
A. C. JANNI,
W. M. WILSON.

November 29, 1924.

Progress Report of Special Committee on Flood Protection Data*

To the Board of Direction,
American Society of Civil Engineers:

The activities of the Special Committee on Flood Protection Data during the past year have been concerned mainly with the compilation of data pertaining to stage, discharge, and frequency of floods of various magnitudes on streams selected as typifying conditions met with in different parts of the United States. The information was put in tabular form following the uniform system devised by the Committee during the previous year, and is now in such shape as to make possible its further study in a variety of ways. In all, 139 streams were so treated, the data being taken from the longest and best records available. The great amount of work accomplished is attributable largely to the co-operation extended to the Committee by the engineers of the Water Resources Branch of the U. S. Geological Survey and by other engineers.

The Committee met on the following dates at Society Headquarters in New York: January 17 and September 3, 1924. In addition to initiating and directing the work described, the Committee has given careful consideration to the scope of its duties as implied by its title, and as a result has decided to confine its operations for the present to the following:

(1) To collect data pertaining to stage, discharge, and frequency of floods for a large number of streams, and to condense these data in such form as to be of maximum utility to the profession.
(2) To compile data descriptive of the various flood-protection systems now in operation and to make this information available to the profession in convenient form for reference.

The former of these tasks was considered not only as being fundamental to any further work to be undertaken, but as of the greater immediate value, in view of the urgent need for authoritative data of this kind on the part of practising engineers. The recognition that the compilation of data, necessarily so large in amount, and their proper analysis and conversion into compact form would involve much time and labor, has accentuated the need for promptly initiating the work that would lead to the publication of the principal facts related to the occurrence of floods. Consequently, all efforts to date have been concentrated in this direction.

The Committee is now engaged in working out proper methods of presenting a digest of the flood data collected and yet to be collected. Its desire is to put this material in such form that it may be readily understood and used by engineers with flood problems, and permit them to exercise their judgment as to the extent of its applicability to such problems. A graphical representation is being sought that will accomplish these ends and that will also be capable of future extension or modification as additional data become available. It is desired to avoid the use of empirical formulas or any other form of presentation of which the derivation is not self-evident or which is likely to lead to misuse or to doubts in the mind of the user as to its being properly

* Presented to the Annual Meeting, January 21, 1925.

applicable to any specific use. In short, to be of real practical value to the profession, the final product of the Committee's labors should operate to relieve the practising engineer from a vast amount of research work rather than to add to his burdens. Illustrative of what the Committee has in mind, in a general sense, reference is invited to diagrams showing flood frequency, appearing in *Bulletin No. 5* of the Report on the Water Resources of California, published in 1923 by the Department of Public Works of that State.

It is hoped that by means of these and other studies the flood characteristics of streams may be so correlated with climate, physiography, geology, soil, vegetal cover, and works of man in the basins that reasonable predictions may be made for streams for which no or incomplete records are available.

The operations of the Committee to date have been carried on at a minimum of expense, thanks to the extensive co-operation referred to. The Committee feels that during the coming year doubtless much additional information may be obtained from these and other gratuitous sources. It is convinced, however, that the work of analyzing the data and their conversion into graphical form cannot be performed through the medium of volunteer service. This task calls for the expert services of an engineer who is thoroughly familiar with the interpretation of flood data, who can be depended upon to devote his time exclusively to this work for a period of a year or more, who would possess the necessary responsibility, initiative, and inborn love for research essential to carrying such a task to a successful conclusion under the general direction of the Committee, and who finally could be relied upon to prepare the results in the best form for publication by the Society. Although primarily a one-man job, it is probable that, at times, the work could be expedited and made less costly by furnishing such an engineer with a clerk or computer.

An important duty that would devolve upon this engineer would be to make search in the scattered records to be found in many cities for flood data needed to bring the studies for a given stream or region to completion. This, in most instances, would include searching for data pertaining to floods that antedate the periods covered by systematic gauge records.

The Committee estimates that funds in the amount of $10 000 will be needed during the coming year for the purposes herein set forth, and has submitted a detailed estimate to the Board of Direction requesting that this amount be made available. The Committee is convinced that the results to be obtained will form a contribution to engineering science of such intensely practical value as fully to warrant the expenditures involved.

Respectfully submitted,

N. C. Grover, *Chairman*,
C. B. Burdick,
W. P. Creager,
Harrison P. Eddy,
Gerard H. Matthes,
Charles H. Paul,
A. O. Ridgway.

September 26, 1924.

Progress Report of Special Committee on Irrigation Hydraulics*

To the Board of Direction,
American Society of Civil Engineers:

Gentlemen.—As stated in the Progress Report for 1923,† certain subjects have been selected by the Committee for investigation and research. The first task, that of preparing a bibliography on each subject, has been practically completed.

The Committee, composed as it is of men busy with their own affairs and limited as to funds—none in fact for actual research—can do little more than act as a clearing house through which, by means of analysis and suggestion, the efforts of others may be directed into channels that will stimulate and co-ordinate the work, and provide an effective means of broadcasting the results.

The Committee acknowledges with sincere thanks the splendid co-operation that is being given by the Bureau of Reclamation and the Department of Agriculture, as well as other Government and private agencies. Without such co-operation the work of the Committee would be impossible.

A meeting of the Committee was held at Portland, Ore., September 5 and 6, 1924, at which there were present Messrs. Allison, Henny, Parshall, Scobey, Stevens, and Thomas. At this meeting, specifications were drawn up for each subject as a guide to the preparation of the bibliography.

As a result of this meeting certain data on some of the selected subjects were secured and are presented in the form of papers to be published by the Society, as follows:

"Measuring Irrigation Deliveries", a paper descriptive of the Improved Venturi Flume by R. L. Parshall, Affiliate, Am. Soc. C. E.

"The Design of Side Channel Spillways", a paper by Julian Hinds, M. Am. Soc. C. E.

"Permissible Canal Velocities", a final report of the Committee, prepared largely by Samuel Fortier and Fred C. Scobey, Members, Am. Soc. C. E.

"The Silt Problem", a joint paper by Franklin Thomas and Fred D. Pyle, Members, Am. Soc. C. E., published as a part of this report.‡

In addition to the bibliography appended to this report (Appendix I), there are a large number of data in the office files of the U. S. Bureau of Reclamation, contained in special reports and project histories. As these are not available for general distribution, a digest of available data on each subject is being prepared under the direction of J. L. Savage, M. Am. Soc. C. E. Engineers in the Designing Section of the Bureau have accepted assignments of abstracting these data to aid the work of the Committee, as follows:

I.—Evaporation Losses from Reservoirs, Mr. E. B. Debler.
II.—Losses in Canal Conversions, Julian Hinds, M. Am. Soc. C. E.
III.—Water Movement and Pressure Under Dams, Mr. R. D. Hubbard.

* Presented to the Annual Meeting, January 21. 1925.
† *Proceedings*, Am. Soc. C. E., March, 1924, Society Affairs, p. 288.
‡ See p. 141.

IV.—Losses in Siphon Spillways, W. H. Nalder, Assoc. M. Am. Soc. C. E.

V.—The Silt Problem, I. E. Houk, M. Am. Soc. C. E.

VI.—Chutes and Drops, Mr. H. R. McBirney.

VII.—Scouring Below Dams, W. H. Nalder, Assoc. M. Am. Soc. C. E.

VIII.—Measuring Irrigation Deliveries, I. E. Houk, M. Am. Soc. C. E.

IX.—The Design of Side Channel Spillways, Julian Hinds, M. Am. Soc. C. E.

Status of Investigations by Subjects

The following statement shows the status of the work to date on each selected subject, exclusive of the preparation of the bibliography, which is submitted in Appendix I.

I.—Evaporation Losses from Reservoirs.—The losses by evaporation from reservoirs have been inferred almost entirely from the observed evaporation from pans of various sizes and shapes. The Committee hopes to secure some reliable data as to the evaporation from certain reservoirs by direct observation.

The East Park Reservoir of the Orland Project, California, so far as known, is completely water-tight. The inflow becomes small as spring advances and can be accurately measured. In normal years there is a period of several weeks when gates can be kept closed and evaporation is fairly high. Plans were perfected for comparing pan evaporation with reservoir contents and inflow, but the exceptionally low run-off compelled draft on the reservoir early in 1924. As no sufficiently accurate measuring devices are at hand for measuring the outflow, observations have been postponed until 1925, conditioned on co-operation by the U. S. Bureau of Reclamation. From these data it is hoped certain relations may be established by which the observed evaporation from pans may be interpreted in terms of large reservoir surfaces.

II.—Losses in Canal Conversions.—The losses included under this caption are those that occur when changes are made from one shape or size of conduit to another, that involve changes in velocity. To effect such a change comparatively short conversion sections are interposed between the two conduits. The losses that occur in such sections are those under study by the Committee.

It appears to be well established that where velocities are increased very simple conversion sections, involving little more than rounded entrances to prevent cavitation, suffice to effect the transformation from low to high velocity without energy loss. The reverse transformation, however, from high to low velocity, apparently cannot be made without some energy loss.

Field tests on existing conversion structures, made by the Bureau of Reclamation, U. S. Department of Agriculture, and others, show a failure to recover much more than one-half the velocity head, although some results show a recovery of as high as 90 per cent. Most of the field tests, however, have failed to take account of the drop due to difference in elevations of the channel bed on each side of the conversion. If the water in the down-stream conduit

had been dammed up as high as possible without raising the water surface in the conduit above, the maximum efficiency of that particular conversion section would have been obtained instead of the actual efficiency, under the conditions existing at the time of making the test.

Theoretically, as long as mean velocities are dealt with, gradual enlargements may be made without energy loss; practically, they cannot. Aside from ordinary channel friction, there is an inherent loss due to what has been called "induced currents."* No satisfactory mathematical treatment for them has yet been developed. The results so far obtained are empirical and based for the most part on pipe diffusers.

For pressure pipes it was found that polishing added very little to the efficiency of the diffuser over a smooth casting; that the maximum efficiency obtained with diffusers having a total angle of dilation of 7 to 8°; that an angle of 60° causes greater losses than a sudden enlargement; that the straight-sided diffusers are better than bellmouth diffusers; and that giving the water a rotary motion increases the efficiency of the diffuser.

Until recently systematic experiments on open channel enlargements were almost entirely lacking. Through the efforts of the Committee a series of experiments are now in progress under the direction of Mr. Scobey and B. A. Etcheverry, Assoc. M. Am. Soc. C. E., at the University of California. The first results of these tests are in the Committee's files in the form of a report on "Experimental Hydraulics of Flume Transitions." The work was done as a thesis prepared in the Department of Irrigation of the University, by Mr. Irvin M. Ingerson, a candidate for the degree of Bachelor of Science in Civil Engineering in May, 1924.

These tests show that losses may be entirely eliminated by short simple transitions where velocities increase, but that long warped sections are required to reduce losses to a minimum where velocities decrease.

For enlargements, it is shown that the ordinary short transition section is no better than a square head-wall and that they recover less than half the velocity head, whereas as high as 90% of the velocity head was recovered in long contracted parabolic vertical walled enlargements.

As is usual, the experimenter found that his first efforts merely pointed to additional work that was necessary before conclusions are justified. Some field tests by the U. S. Bureau of Reclamation on existing conversion sections have been made, others are contemplated.

The Committee awaits the results of these field and laboratory tests before preparing a report on this subject.

III.—Water Movement and Pressure Under Dams.—A brief report of the aims and purposes of a joint investigation of this subject by the U. S. Department of Agriculture and the Bureau of Reclamation under the immediate direction of A. L. Fellows, Senior Irrigation Engineer, U. S. Department of Agriculture, Denver, Colo., which is now in progress, has been published.†

* "Induced Currents of Fluids", by F. zur Nedden, *Transactions*, Am. Soc. C. E., Vol. LXXX (1916), p. 844.

† *Engineering News-Record*, March 1, 1923.

The Committee has been in correspondence with Mr. Fellows and has furnished some data, notably that on the Coquille City Dam.*

It is not the purpose of the Committee to duplicate work, but rather to cooperate with other agencies wherever possible. As this subject will doubtless be treated quite exhaustively in Mr. Fellows' final report, the Committee will await its appearance with considerable interest. Any phase of the subject not fully covered in the report may then be taken up by the Committee.

IV.—Losses in Siphon Spillways.—The use of siphon spillways has the advantage of providing effective regulation of water level for reservoirs or forebays, with fluctuations of only a few inches.

The losses result mostly from the disturbances at entrance and exit and at the bends.

There appears to be an unnecessary difference of opinion as to just what is the head on a siphon and whether or not this head can theoretically exceed that corresponding to a perfect vacuum. Some uniform method of treatment is necessary, and the Committee hopes to formulate certain specifications by which tests may be compared on a uniform basis.

In addition to the data already available in published form, the Committee has in its files a paper on this subject by Mr. Arthur Cramer, prepared under the direction of Stuart H. Sims, M. Am. Soc. C. E., Head of the Civil Engineering Department, Oregon Agricultural College. This paper was one of the prize papers read before the Portland Section of the Society in 1924, and contains a fair presentation of the theory involved.

Professor Thomas, of the California Institute of Technology, has had some model siphons made for laboratory experimental work at that institution. The results so far obtained, however, are too incomplete for presentation at this time. The Committee's report on this subject, therefore, is withheld until more experimental data have been gathered.

V.—The Silt Problem.—The silt problem, as herein understood, refers to the settlement of silt in irrigation canals and reservoirs, causing reduction of capacity and necessitating heavy maintenance expense. In its most serious form it is generally confined to irrigation enterprises which derive their supply from silt-carrying streams. Silt is understood to be that material which is carried in suspension by the stream and by irrigation canals with ordinary velocities. The term may be considered to apply to a combination of very fine sand, silt, and clay as classified by the U. S. Department of Agriculture, most of the particles being less than 0.1 mm. in size, which is about the same as the openings in a 150-mesh sieve. Coarser materials like sand and gravel, shifting along the bottom of canals, are not intended to be included.

In May, 1924, a questionnaire on this subject was sent by the Committee to a selected list of 172 irrigation engineers, operators, and managers. The replies received were given to Professor Thomas, who enlisted the aid of Mr. F. D. Pyle in the preparation of a joint report on this subject, as follows:

* See discussion of the paper entitled "The Design of Earth Dams", by Joel D. Justin, M. Am. Soc. C. E., *Transactions*, Vol. LXXXVII (1924), p. 1.

REPORT ON THE SILT PROBLEM

By Fred D. Pyle* and Franklin Thomas,† Members, Am. Soc. C. E.
(With Additions by the Committee)

Silt Content of Water and Weight of Silt.—The quantity of silt carried by water is frequently determined from samples taken at different depths and is then expressed by the relation between weight of water and of dried silt, or between their volumes. This relation, given in percentage, does not in itself give a correct idea of the volume which such silt, if settled in a canal or reservoir, will occupy.

The specific gravity of silt does not ordinarily show wide variations. L. M. Lawson, M. Am. Soc. C. E., reports the following values:

Colorado River silt	2.60
Gila River silt	2.55
Rio Grande silt	2.64

Values of approximately 2.65 have generally been found for silt and clay in hydraulic dam construction.

The late W. W. Follett, M. Am. Soc. C E., determined the weight of a 3-in. cube of silt, taken from an exposed bank in the Rio Grande and artificially dried, to be 0.827 lb., or 53 lb. per cu. ft.

Mr. Lawson found the weight of silt, taken from an exposed bank of the Colorado River and artificially dried, to be 86 lb. per cu. ft.

Ray S. Carberry, M. Am. Soc. C. E., reports the weight of silt as determined from a dry, recently deposited bank in Imperial Valley as 10 lb. 15 oz. for a 6-in. cube, or 87.5 lb. per cu. ft.

A comparison by D. C. Henny, M. Am. Soc. C. E., of weight of silt by analysis of Rio Grande water and space occupied in the Elephant Butte Reservoir, covering the period, January 1, 1919, to September 1, 1920, indicates a weight in 1 cu. ft. of settled silt of 54 lb., corresponding to a wet weight of 97 lb.

The volume occupied by a given dry weight of silt is almost entirely determined by the proportion of its voids. On the basis of a specific gravity of 2.60, the percentages of voids for the cases mentioned would compare, as follows:

Weight of dry silt in 1 cu. ft. of settled silt, in pounds.	Percentage of voids.
53	67.5
86	47.2
54	66.8
87.5	46.2

The percentage of voids in settled silt is the composite result of various factors, of which the readiness with which surplus water can be forced out under compression, the degree of compression, and, to some extent, the time element are probably controlling. Sizes of particles and their gradations as well as the percentage of colloids, all determine drainage qualities.

Quantity of Silt Carried by Rivers.—The silt problem of an irrigation project may be negligible or acute depending upon the quantity of silt carried by the stream constituting the source of supply, except where silt may result from erosion within the system due to peculiar hydraulic conditions.

A number of determinations of the silt carried at various seasons have been made of the waters of the Colorado River and the Rio Grande.

* Irrig. Engr., Imperial Irrig. Dist., Imperial, Calif.
† Prof. of Civ. Eng., California Inst. of Technology, Pasadena, Calif.

On the Rio Grande, at El Paso, Tex., the late Mr. Follett found for a 16-year period—1899 to 1912, inclusive—an average silt content of 1.66%, by weight, with the average per year ranging from 0.76% to 4.14 per cent.*

On the Colorado at Yuma, Ariz., Mr. Lawson found the mean silt content from 1909 to 1916, by weight, to be 0.70% without Gila River flow, and 0.93% during Gila flow.

It has been observed at Yuma that the percentage of silt content is less at the peak of the summer flood than during the rise and recession of the stream.

Mr. Lawson found that the percentage of silt increased with rising velocities. When a flow of 26 000 sec-ft. was reached, the maximum velocity of approximately 6 ft. per sec. occurred and was maintained for higher discharges. The lowest percentage of silt was noted at times of lowest run-off.

The proportions of silt carried by the Colorado are shown by Table 1.

TABLE 1.—COLORADO RIVER AT YUMA.

MEAN SILT RATIO BY WEIGHT, BY MONTHS, 1914.

Month.	Percentage.	Month.	Percentage.
January	0.0048	July	0.0100
February	0.0078	August	0.0120
March	0.0095	September	0.0068
April	0.0123	October	0.0088
May	0.0098	November	0.0070
June	0.0048	December	0.0086

AVERAGE MEAN MONTHLY SILT RATIO BY WEIGHT OF COLORADO RIVER, AT YUMA, 1912 TO 1924.

Month.	Percentage.	Month.	Percentage.
January	0.0055	July	0.0089
February	0.0061	August	0.0129
March	0.0082	September	0.0088
April	0.0081	October	0.0089
May	0.0090	November	0.0052
June	0.0065	December	0.0045

Mr. Henny prepared the figures shown in Table 2 from silt surveys of the Elephant Butte Reservoir on the Rio Grande.

TABLE 2.

	Inflow, in acre-feet, water and silt.	Silt, in acre-feet.	Percentage of silt in settled condition.
January 1, 1915-August 10, 1916	2 628 000	49 242	1.873
August 11, 1916-September 1, 1920	5 543 000	90 858	1.639
Total	8 171 000	140 100	1.714

The silt accretion found by survey undoubtedly contains a small percentage of sand carried by the stream at times of severe floods.

Disposal of Silt.—The importance of removing a maximum proportion of silt from the water entering the canal at the point of diversion is fully realized

* See U. S. Geological Survey, *Water Supply Paper 358.*

by irrigation engineers. This is accomplished by sluicing and skimming. Sluicing is done either continuously or periodically, depending on local conditions and available excess water supply and drop. By periodical sluicing and skimming, it is claimed that at times 50% of the silt was removed from Colorado River water at the Laguna Dam, near Yuma, before it entered the main canal. At the head-works of the Imperial Valley Canal sluicing is not practicable because of lack of drop and of available water supply.

Either as a supplementary measure or where adequate sluicing at the intake is not possible, sluiceways and sand traps at suitable locations in the canal are effective in lowering the silt content. Where this is not practicable, it may be necessary for the removal of silt not carried to the land to resort to dredging operations, as is done by the Imperial Irrigation District where two electrically operated suction dredges work intermittently, equivalent to one dredge pumping silt 3 to 5 months of each year.

Little information is available as to the total volume of silt deposited per season in canal systems, but the Imperial Irrigation District has computed since 1912 the quantity of silt in suspension, in acre-feet, entering its canal system. These quantities are based on the silt content determination made at Yuma by the U. S. Reclamation Bureau. They are shown in Table 3.

TABLE 3.

Year.	Acre-feet.	Cubic yards.
1912	8 438	13 600 000
1913	9 658	15 600 000
1914	11 850	19 100 000
1915	11 385	18 400 000
1916	18 575	30 000 000
1917	8 478	13 700 000
1918	11 006	17 800 000
1919	19 244	31 100 000
1920	15 139	24 400 000
1921	12 738	20 600 000
1922	17 093	27 600 000
1923	24 928	40 200 000

The diversion during heavy silt-carrying periods ranged from 5 000 to 7 000 sec-ft. At other times, it was as low as 3 000 sec-ft.

A large part of the silt entering a canal system passes on to the land irrigated, and considerable quantities are removed by sluicing, with some remaining in the canals as they build up. Where silt is deposited in the canal, either in the bottom as bars or on the sides as berm, it is necessary to remove such deposits by various types of dredges, by teams, or by hand labor.

Mr. Ray S. Carberry, Chief Engineer, Imperial Irrigation District, has estimated the total quantity of silt carried on to the lands in the United States in the Imperial Valley in 1923 as 20 607 000 cu. yd. This quantity if spread evenly over the 420 000 cultivated acres would be sufficient to raise the lands nearly 0.031 ft. per year, or 1 ft. in 32 years.

H. M. Rouse, Assoc. M. Am. Soc. C. E., in January, February, and March, 1914, took samples 1 000 ft. above Hanlon Gate in the Alamo Canal diverting from the Colorado River. It was found that the total quantity of silt, including sand in suspension, was practically the same at 0.2 depth and 0.8 depth, although the sand content of the silt was almost uniformly twice as much at the 0.8 depth as at the 0.2 depth.

C. E. Atwood, Assoc. M. Am. Soc. C. E., reports on the Valier, Mont., Carey Act Project, with 490 miles of canals, the water supply of which is the Marias River, that, in 1923, due to excessive gradients and consequent erosion, 19 800 cu. yd. of silt were removed, the mains being cleaned on an average of once in three years; the laterals on an average of once in two years.

In the Imperial Irrigation District the larger main canals sluice as the discharges increase and it is necessary to remove the berm with dragline or dipper dredge on an average of once in five years, the small canals once in three to four years. The laterals are cleaned with Ruth dredges on an average of both sides once a year, although a small mileage has to be cleaned both sides twice a year. Some of the small flat laterals have to be cleaned with Mexican labor every three months.

Cost of Removal.—The cost of removal of silt varies widely with the method required. Mr. M. E. Bunger gives the cost of removal in the system of the Model Land and Irrigation Company of Trinidad, Colo., with teams, as 20 to 30 cents per cu. yd. for a quantity of 1 000 cu. yd. per annum.

Mr. Atwood gives the cost of removal of silt on the Valier Project, Montana, of which 19 800 cu. yd. were removed in 1923, when dry as 30 cents per cu. yd.; wet, 60 cents per cu. yd.

The removal of silt from the canals of the Imperial Irrigation District is accomplished at the following prices per cubic yard for various methods: Suction dredge, 5 cents; dragline, 15 cents; Ruth dredge, 20 to 30 cents; hand labor, 50 cents to $1.00.

Hydraulic Features That Prevent Deposits.—When conditions do not permit the material reduction of the silt content of the water diverted to the canals, the silt in transit is most economically disposed of if carried out upon the land. The use of such hydraulic properties in canal design as will facilitate the transportation of silt is desirable. The most valuable work in this direction has been done by Mr. R. G. Kennedy as a result of observations on the Bari Doab Canal.

George E. Beaver, General Manager of Twin Lakes Reservoir and Canal Company, Ordway, Colo., reported that in a diversion of 800 sec-ft. from the Arkansas River during the silt period, a grade of 1.06 ft. per mile was effective in causing the silt to be "all drawn out on the land".

W. H. Code, M. Am. Soc. C. E., reported his observation that suspended silt was carried to the land if the canal velocity is 2.5 ft. per sec. or more.

F. C. Emerson, M. Am. Soc. C. E., State Engineer of Wyoming, advanced the opinion that a velocity of 2 ft. per sec. usually assured a clean section and further stated that "where the canal is accessible to grazing animals and vegetation is kept down, with capacity flow, a clean section will be maintained".

The changed conditions resulting from the construction of a reservoir upon a stream carrying a large quantity of silt is cited by Mr. L. M. Lawson, Project Manager, Rio Grande Project, El Paso, Tex., who states: "We are able to reduce our operating cost a large amount by sluicing accumulations of sand which took the place of former clay silt."

In the canals of the Imperial Irrigation District, having a flow in excess of 4 sec-ft., velocities of more than 2 ft. per sec. carry all but the heavy sands. The sand deposits are effectively removed where the check-gates can be opened and the canals are sluiced out. Scouring velocities, ranging from 4 to 7 ft. per sec., maintained for 2 days, give excellent results.

S. L. Rothery, Assoc. M. Am. Soc. C. E., pointed out that no aquatic growth occurs in canals carrying silty water, whereas, on the other hand, the tendency of the silt to form a berm in the canal encourages the growth of grass and plants which prevent scouring along the sides so that the canal assumes a rectangular section.

In addition to references previously made for information contributed, acknowledgment is made to M. J. Dowd, Jun. Am. Soc. C. E.; J. H. Fertig, M. Am. Soc. C. E.; J. C. Nagle, M. Am. Soc. C. E., and Mr. C. H. Taylor.

VI.—Chutes and Drops.—This subject is being handled by the engineers of the U. S. Bureau of Reclamation under the direction of Mr. J. L. Savage. A number of standard designs of drops have been completed and work is under way as time permits on the standardization of chutes.

The necessity for field tests on their behavior is obvious, and no report on this subject will be submitted by the Committee until theory, experimental data, and practical design have been brought to a satisfactory correlation.

VII.—Scouring Below Dams.—The bibliography (Appendix I) presented with the Committee's report points to practically all the available data on this subject at present.

The Committee has made no special assignments on this subject, but will gather by correspondence the results of experience on existing structures.

VIII.—Measuring Irrigation Deliveries.—The pay-for-what-is-consumed principle in irrigation, if it can be applied in practice, promises to eliminate many of the perplexing problems of irrigation managers and operators. It will reduce waste, eliminate the "water-hog", and so conserve the available supplies that on many projects additional lands may be irrigated without increasing the diversions.

The great obstacle in the general adoption of this principle is the lack of suitable devices or structures by which deliveries may be measured in a practical way and that are within the financial resources of the individual or the district.

On account of the importance of this feature to irrigation institutions generally, the subject of measuring irrigation deliveries was one of those selected by the Committee for study.

The structure described in Mr. Parshall's paper has been developed by the engineers of the U. S. Department of Agriculture in its co-operative irrigation investigations. One type of Venturi flume was developed by Mr. V. M. Cone, another by Mr. Henny. The present type known as the "Improved Venturi Flume" is largely the result of development work by Mr. Parshall, utilizing the principle of the hydraulic control.

Another device known as the "Control Flume" has been developed and experimented with by the U. S. Bureau of Reclamation. It is expected that this structure will be made the subject of another paper to be submitted under the auspices of the Committee at some future date.

Believing that the Improved Venturi Flume is a very promising measuring device for both large and small quantities of water, the Committee asked Mr. Parshall for a paper descriptive of the structure, and the results of tests that so far had been made.

IX.—The Design of Side Channel Spillways.—The construction of suitable spillways for non-overflow dams in deep canyons is often a perplexing problem on account of the limited space available for such a structure.

The devices used for this purpose are siphon spillways, tunnel spillways, shaft spillways, and side channel spillways. The latter type consists essentially of a canal excavated in the canyon side roughly perpendicular to the center line of the dam. The up-stream portion terminates within the reservoir at a sufficient distance away from the dam to provide the length of spillway required. The down-stream portion terminates in a chute or drop that delivers the surplus waters to the stream far enough below the dam to avoid damage to that structure. The reservoir side of the portion of the spillway channel up stream from the dam is an overflow wall or spillway either level or slightly

inclined. Obviously, the cross-sectional area of this portion of the canal must increase down stream to the center line of the dam on account of the continually increasing flow.

The hydraulics of such a spillway are quite involved and economy of design can only be effected by combining experimental data with theoretical treatment.

On account of the importance of this type of spillway in irrigation storage reservoirs, the subject of the proper design of side channel spillways was one of those selected by the Committee for study.

The U. S. Bureau of Reclamation is just completing a large spillway of this type at the Rimrock Dam on Tieton River in the Yakima water-shed. in Washington. There is also one at the Arrowrock Dam on the Boise, Idaho, Project; and another at the Don Pedro Dam for the Modesto-Turlock Irrigation Districts, in California.

The design of the Rimrock Spillway was largely prepared by Mr. Julian Hinds, under the direction of Mr. J. L. Savage, and Mr. Hinds kindly consented to prepare a paper embodying the theoretical treatment evolved by him as well as the results of experimental data so far obtained.

The treatment by Mr. Hinds is based on the theory of the conservation of momentum and involves the hypothesis that not only is the energy of the water falling over the spillway entirely destroyed by impact in the channel but the impact itself causes additional losses. Although the results of the experiments presented show a fair conformity to theory, they involve too many other factors, such as entrained air and greatly varying velocities in sections normal to the channel, to determine the exact truth of the hypothesis. The problem of making such experiments in a manner to test the hypothesis accurately can probably be solved only in a suitable laboratory, and efforts are being made by the Committee to have such tests performed in the near future. The final report of the Committee on this subject will await the results of such experiments and additional field tests that are planned on existing spillways.

X.—Permissible Canal Velocities.—The proper velocity to be allowed in canals excavated in the great variety of soils and indurated materials encountered in practice, can only be determined by experience.

The term, permissible canal velocity, is taken to mean the highest mean velocity that will not scour bed or banks, and, at the same time, will prevent as far as possible the deposition of silts and the growth of aquatic plants. These limits often overlap, leaving no margin. The growth of aquatic plants often depends more on temperature and clearness of water than velocity. The susceptibility to scour often changes with silt deposits or moss growth. It is evident, therefore, that the data secured as a result of experience cannot be promiscuously applied. Nevertheless, such data are valuable aids in design.

With a view to compiling the results of experience, the Committee sent a questionnaire on this subject to a list of nearly 200 irrigation engineers, managers, and operators. Twenty-five replies were received, of which ten contained data of value. The data thus secured, as well as all other available information, have been utilized by Messrs. Fortier and Scobey, who, acting as a Sub-Committee, have prepared a paper entitled, "Permissible Canal Velocities". This paper constitutes the Committee's final report on this subject.

The Committee wishes to acknowledge the excellent work done by Messrs. Fortier and Scobey in the preparation of this report, and extends its sincere thanks to them for it.

The plans for 1925 contemplate a continuation of the work under way. A meeting is planned for some time in July, at Ogden or Salt Lake City, Utah, and another in the fall, probably at San Francisco, Calif. It is hoped that the Committee, with change in personnel if the Board desires, will be continued until final reports have been prepared on each of the selected subjects.

Respectfully submitted,

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November 15, 1924.

APPENDIX I

BIBLIOGRAPHY ON SUBJECTS SELECTED FOR RESEARCH BY THE SPECIAL COMMITTEE ON IRRIGATION HYDRAULICS

The following bibliography is the composite work of the members of the Committee. It is not offered as exhaustive; it lists only articles and papers strictly germane to the subject. In most cases a brief synopsis of each reference is appended.

I.—EVAPORATION LOSSES FROM RESERVOIRS

The Loss of Water from Reservoirs by Seepage and Evaporation.
L. G. Carpenter. (Colorado Experiment Station *Bulletin 45*, 1898.) Contains a tabular summary of losses from Colorado reservoirs. Discusses losses due to seepage alone. Gives tables of evaporation losses.

Observations on Rate of Evaporation of Water Over Reservoirs and Lakes.
Frank H. Bigelow. (*Monthly Weather Review*, v. 36, pp. 24–30, 1908.) Description of apparatus used in evaporation studies in reservoir at Reno, Nev., 1907. Methods of taking observations; illustrations; discussion of the Reno observations; formulas for the evaporation of water; summary and conclusions. Author concludes that it seems probable that a lake or reservoir evaporates about five-eighths as fast as an isolated pan placed outside the vapor blanket; in other words, this vapor blanket seems to conserve about three-eighths of the water that would otherwise be lost by the evaporation.

Allowance for Evaporation from Reservoir Surfaces.
H. M. Chittenden. (*Engineering News*, January 16, 1913.) Author impressed by careless method of engineers in making allowances for evaporation. Correct method is to compute run-off independent of reservoir area, add to run-off (= rainfall) on reservoir itself, and deduce the surface evaporation. Algebraic expression given for the yield from the water-shed is given, also specific application to Lake Superior. An anticipated criticism of the average depth of run-off for the water-shed for the same period is given.

Reservoir and Canal Losses in Irrigation.

E. G. Hopson. (*Engineering News*, March 27, 1913.) Abstract of paper by Mr. Hopson entitled "The Economic Aspect of Seepage and Other Losses in Irrigation Systems," *Transactions*, Am. Soc. C. E., Vol. LXXVI (1913), p. 336. Reservoir evaporations on East Park, Cold Springs, and Deer Flat Reservoirs (U. S. Reclamation Service), 1908–11, average 10% of inflow; on Clear Lake Reservoir, 45 per cent.

Evaporation from a Plain Water Surface.

J. W. Leather. (Memorandum, Dept. of Agriculture, India, Chemical Ser. No. 3, 1913.) A description is given of the evaporimeter in use at Pusa which consists essentially of a circular cement tank 6½ ft. in diameter and 5 ft. deep, with an adjustable pointer for measuring the water level. Records for 1911 and 1912 are tabulated and compared with other data obtained from observatories at Madras and Lyallpur. The rate of evaporation during the cold weather months was much the same at Pusa and Lyallpur, but much higher at Lyallpur throughout the six hot months from May to October. At Pusa, during the hottest months, the rate of evaporation was three times that of the coldest months; at Lyallpur five times; and at Madras not quite twice that of the coldest months.

— Abstract. (International Inst. of Agriculture, Rome, Bureau of Agricultural Intelligence and Plant Disease, *Monthly Bulletin No. 4* (1912), No. 8, pp. 1186-1187.)

Summary and Study of Evaporation Experiments at Salton Sea.

F. T. Robson. (*Engineering and Contracting*, September 24, 1913.) Reprint from *Transactions*, Am. Soc. C. E., Vol. LXXVI (1913), p. 1516. An exclusive article.

Evaporation and Seepage from Irrigation Reservoirs.

Kenneth A. Heron. (*Engineering News*, August 12, 1915.) Gives losses from Dallas and Warner Reservoirs of Modesto Irrigation District (Calif.). Loss determined by use of 3 by 3-ft. floating pan; loss measured by adding water to pan until surface within is brought to predetermined level as indicated by sharp vertical pin. Results are given showing the loss by evaporation and also the loss by seepage, in acre-feet per acre, of submerged area within the reservoir. A diagram is given to show seepage loss per month per acre-foot of reservoir bottom to depth of water in reservoir. The water carries little sediment and the bottoms are sand, silt, and adobe underlaid with a hardpan layer from 2 to 8 ft. thick.

Atmospheric Influence on Evaporation and Its Direct Measurement.

(*Monthly Weather Review, No. 43*, 1915, p. 126.) Deals briefly with some general principles of atmomerty and discusses relative merits of different types of atmometers, especially the clay-cup atmometer. It is stated that the latter possesses all the advantages over the free water surface that are possessed by the Piche, Piche-Cantoni, and Bellani instruments. Its main advantage over these instruments lies in the fact that its surface projects into the air and is exposed equally to wind action in all directions. Its surface is somewhat similar to that of plants, which is also the surface of a water-imbibed solid, and its exposure to the surrounding aerial conditions is similar to the mean exposure of the surfaces of the foliage of an entire plant. For this reason it has proved especially valuable in studies bearing on water loss from plants. The rigidity of the cups also makes them more satisfactory than the somewhat flexible paper disks. A bibliography is appended.

Annual Evaporation from Lake Conchos, Mexico.

Edwin Duryea and H. L. Haehl. (*Transactions*, Am. Soc. C. E., Vol. LXXX (1916), p. 1829.) Yearly evaporation depth determined by pan method and checked by inflow and outflow to and from reservoir. Fifty-five inches was adopted as a safe yearly evaporation depth. General description of reservoir and assumptions relative to interpretation of data; conclusions. Appendix gives comparison of data, together with conclusions. Discussion.

Evaporation.

Percy V. O'Brien. (*Minutes of Proceedings*, Inst. C. E., Vol. CCV (1917).) Mr. O'Brien states that measurements of evaporation were made during 1910-11-12 at Coolgardie and Menzies, with a micrometer instrument, the velocity and direction of wind being also noted by an anemometer registering on a drum. The information collected showed that: (*a*) The annual loss by evaporation may fairly be taken to average 9½ ft. at Coolgardie and 12 ft. at Menzies; (*b*) the measured evaporation for 1910 was: At Coolgardie, 10 ft., 64.4° Fahr.; at Menzies, 100 miles north of Coolgardie, 13 ft., 66.6° Fahr.; at Laverton, 180 miles north-northeast of Coolgardie, 15 ft., 67.8° Fahr.; and at Cue, 330 miles northwest of Coolgardie, 15 ft., 70.6° Fahr.; (*c*) apart from the question of humidity of atmosphere and temperature the velocity of wind affects evaporation to a great extent; and (*d*) the results obtained by using wet and dry-bulb thermometers agree closely enough with the reading of the micrometer instruments. The difference in evaporation at the four places named is due to the prevailing winds in the hot season and to the geographical position of each place.

Evaporation from the Surfaces of Water and River Bed Materials.

R. B. Sleight. (*Journal of Agricultural Research*, Vol. X, No. 5, July 30, 1917.) In relation to irrigation practice the most pertinent feature is the curve on page 219 showing that a 12-ft. tank evaporates equal to the surface of a large area (such as a reservoir), while a tank, 2 ft. in diameter, evaporates 130% as much; 3 ft., 123%; 4 ft., 118%; 5-ft., 113.5%; etc., the 11-ft. tank evaporating practically as much as the 12-ft. tank.

A New Evaporation Formula.

R. E. Horton. (*Engineering News-Record*, Vol. 78, pp. 196–199, April 26, 1917.) In 1802, Dalton deduced the formula, $E = C\ (V - v)$, in which E is rate of evaporation from a liquid surface, V, vapor pressure corresponding with the temperature of liquid, v, vapor pressure existing in the atmosphere at the time, and C is a constant. The effect of the wind was allowed for by varying the value of C. Later workers have usually introduced a factor of the form, $\frac{l}{l\,w}$ to allow for wind speed w. According to the formula thus modified, the rate of evaporation increased indefinitely with increase of wind, whereas in practice a maximum value is obtained when the wind velocity reaches 15 to 20 miles per hour, and above this there is no further increase. The author, therefore, prefers to allow for wind by the introduction of an exponential factor and deduces the equation, $E = C\ [(2 - e^{-kw})\ V - v]$. Values of the coefficient, $(2 - e^{-kw})$, may be read off from a graph, thus simplifying the working. The formula is also applicable to the case of condensation. It will be seen that

under certain conditions of temperature and humidity condensation will take place in still air, while there will be a slight evaporation under the same conditions in a wind. This result has been verified in practice. The formula as stated applies to a small liquid surface. The latter part of the paper is devoted to a consideration of the case of a larger area where evaporation from the leeward part will be hindered by the presence of the vapor given off by the part more to the windward. The author states that in many cases it will be more accurate to calculate the rate of evaporation from a large surface by the formula here put forward than to rely on attempts at direct measurement with the ordinary type of evaporimeter.

Current Evaporation Observations by the Weather Bureau.

B. C. Kadel and C. Abbe, Jr. (*Monthly Weather Review*, Vol. 44, 1917, p. 674.) Description of equipment and method of observation for Class A evaporation station. Illustrations of micrometer, evaporation hook-gauge, and detail of station; specimen form of notes; no records during freezing weather.

Evaporation Studies in Arizona in 1917.

(Arizona Report, pp. 481–491, 1917.) Evaporation studies made in three localities of widely different climatic conditions, but under approximately similar soil conditions, showed in all three localities a close agreement between temperature and evaporation, which is, however, modified by wind movement. "Reduced to lowest terms, the evaporation rate depends upon temperature and the vapor pressure directly at the water surface." (E. S. R., 1919, p. 379.)

On Evaporation from a Circular Water Surface.

Nesta Thomas and A. Ferguson. (*Journal of Science*, Vol. 6, Ser. 34, No. 202, p. 308, 1917.) Deals with certain elements of uncertainty in the calculation of rate of evaporation from circular water surfaces, reviews work already done on the subject, and describes some experiments which were made on evaporation from circular water surfaces under "everyday conditions". The subject is treated from the purely physical side.

Correlation of Wind Flow and Temperature with Evaporation.

C. A. Shull. (*Plant World*, Vol. 22, No. 7, p. 210, 1919.) Presents a correlation of observations on wind movement, temperature, and evaporation on Mt. Oread, near Lawrence, Kans. This indicates that temperature is the predominant influence in the control of evaporation and that wind movement is a secondary influence.

Relation between Evaporation and Area of Evaporating Surface.

W. Gallenkamp. (*Met. Stschr.*, Vol. 36, Nos. 1-2, p. 16, 1919.) Observations are recorded which show that in all cases the rate of evaporation decreased with an increase in the extent of the evaporating area. The decrease in evaporation, however, was not directly proportional to the increase in surface, being greatest with the first increase in surface and declining with subsequent increases. (E. S. R., 1919, p. 17.)

On Evaporation from a Circular Surface of a Liquid.

(*Monthly Weather Review*, December, 1919, p. 858.) In literature on evaporation the opinion is often expressed or assumed as axiomatic that evaporation from a circular surface is proportional to the area, that is, to the square of the radius of the surface. Stefan, however, showed that theoretically evaporation by diffusion into a quiescent atmosphere would be proportional to the first power of the radius. Miss Thomas and A. Ferguson found that the power of the radius which was necessary to produce the observed results was between 1 and 2. In a dark, very quiet room, the power was 1.4; in a lighted room, it was 1.5 to 1.6; in the open air, it was 1.65. The author by a mathematical treatment of the diffusion of vapor into a flowing gas, finds that evaporation should be proportional to the five-thirds power of the radius. This agrees with value found by Thomas and Ferguson for open air.

Evaporation from Reservoirs.

H. A. Barre. (*Journal of Electricity*, Vol. 46, p. 489, May 15, 1921.) Reviews data collected by Messrs. C. E. Grunsky, N. W. Cummings, and Charles H. Lee. Gives mass curve showing the average annual evaporation at four Arizona stations.

The Efficiency of Irrigation.

G. E. P. Smith. (*Engineering and Contracting*, June 14, 1922.) Discusses the water losses from seepage and evaporation, the distribution and the duty of water.

II.—Losses in Canal Conversions

The Effect of Changes in Canal Cross-Sections Upon the Rate of Flow.

F. W. Hanna. (*Engineering News*, Vol. 57, p. 630, June 6, 1907.) Develops formulas which include the following factors, among others: h_c = loss of head, in feet, due to contraction of canal cross-section; h_e = loss of head, in feet, due to expansion of canal cross-section, and h_f = friction head, in feet, in reducing section.

The Effect of Changes in Canal Grades on the Rate of Flow.

F. W. Hanna. (*Engineering News*, Vol. 58, p. 545, November 21, 1907.) Derivation of a surface curve formula based on Bresse's tables, having general application in irrigation canals.

Conveyance of Water, Vol. I.

B. A. Etcheverry. (McGraw-Hill Book Co., N. Y., 1915.) On pp. 134-137 there is a discussion of transition for change of canal cross-section, including a formula for friction loss in the transition section.

Hydraulic Principles of Flume Intakes and Outlets.

A. C. Norton. (*Engineering News*, Vol. 76, No. 12, p. 541, September 21, 1916.) Suggests conditions for entry losses and outlet recoveries for four types of flume conditions. Accents the fact that flume velocities must be computed from surface elevations and not from bottom slope conditions; also, that all the fall must not be used to maintain velocity, but some must be sacrificed to overcome entry losses and to generate the relatively high velocities in the flume over those in the canal section above the flume.

The Hydraulic Jump in Open Channel Flow at High Velocity.
Karl R. Kennison. (*Transactions*, Am. Soc. C. E., Vol. LXXX (1916), p. 338.) Gives complete analysis of phenomenon of the hydraulic jump, and the relation thereto of critical depth.

Theory of the Hydraulic Jump and Backwater Curves.
Sherman M. Woodward. (Technical Reports, Part III, 1917, The Miami Conservancy District.) This is a complete analysis of the phenomenon of the hydraulic jump, and the losses that occur therein.

Keeping Down Cost and Head Loss on Siphon Outlets.
(*Engineering News-Record*, June 20, 1918, p. 1169.) Offers gently flaring taper from outlet of siphon to open channel section. Vertical sides diminish from full depth at the pipe outlet to 0 at merger with canal. Bottom flat equal to width of pipe at outlet tapering to that of canal at merger. Between flat bottom and vertical sides is a 2.1 slope of concrete paving. A fair practical outlet, avoiding the costs of warped surfaces, but lacking high recovery possibilities.

Experiments in the Flow of Water Through Contraction in an Open Channel.
E. W. Lane. (*Transactions*, Am. Soc. C. E., Vol. LXXXIII (1920), p. 1149.) The experiments consisted of measurements of flow through: (*a*) A contraction with rounded edges, 1 ft. wide; (*b*) a sharp edge contraction, 1 ft. wide; (*c*) a sharp edge contraction, 2 ft. wide; (*d*) a short flume with rounded entrance; (*e*) a short flume with sharp corner entrances; and (*f*) an expanding or Venturi flume. Appendices are attached containing: (1) A brief description of the application of the theory of flow through contracted openings to the design of the flood prevention works of the Miami Conservancy District; and (2) a description of the unstable state of a stream below a sharp edge contraction. Conclusions: The two most common formulas are those of d'Aubuisson and Weisbach. Under certain conditions, one or the other of these formulas may be applicable, while under still another set of conditions, neither should be used. To explain the conditions of flow in an expanding flume, the theory of back-water curves was developed for a frictionless channel with a level bottom and variable width. Certain forms of contractions were found to possess considerable merit as instruments for the measurement of flowing water.

The Hydraulic Jump and Critical Depth in Design.
Julian Hinds. (*Engineering News-Record*, Vol. 85, p. 1034, 1920.) This is a long and valuable article the purpose of which is to show how the design of canals and canal structures may be based on fundamental principles of hydraulic jump and critical depth. The discussion is based on Bernouilli's theorem and the law of the conservation of linear momentum. The article contains graphs showing the relation between energy of flow momentum, and discharge; also diagrams of steady flow with changing velocity in uniform channel, changes of stage in uniform channel, variable cross-sections of canal to flume for transition from high to low stage, faulty intake, jump with varying channel section and bottom slope, transition without jump, transition from one high stage to another due to excess head. From a consideration of the relation between energy of flow, momentum, and discharge, it is concluded that for any depth of flow there is another depth to which the flow may change without intervention of external force, which, however, requires a change in energy of flow.

III.—Water Movement and Pressure Under Dams

Lessons from the Failure of a Weir and Sluices on Porous Foundation.
W. G. Bligh. (*Engineering News*, February 6, 1913.) Stability depends on ratio of length of enforced path of percolation (1) to head (*H*) on structure. Gives percolation factors (1/*H*) of 4 for gravel to 18 for fine sand.

Experiments on Uplift Pressure in Masonry Dams.
C. R. Weidner. (*Engineering News*, July 31, 1913.) Results of experiments on Oester and Neye Dams in Germany both masonry structures 130 ft. in height. Gives hydraulic gradients obtained by pressure pipes, showing decided reduction from heel to toe of dams.

The Action of Water Under Dams.
B. T. Colman. (*Transactions*, Am. Soc. C. E., Vol. LXXX (1916), p. 421.) Mr. Colman shows results of study on action of water under dams, University of Michigan. Porosity and effective size of sand grains and resulting movement of water through porous medium. Conclusions: Loss of pressure head of water in passing from above to below a dam may be divided into three stages: (*a*) a relatively large loss of head, occurring when water enters sand; (*b*) a quite uniform and comparatively small loss of head per foot of length through body of sand; and (*c*) a large loss of head, occurring where water leaves sand. The first stage or entrance loss is increased as length of floor is decreased. Rate of flow decreases very rapidly with depth below floor of structure, being more concentrated for shorter floor. Flow lines, once established in porous medium, tend to continue horizontally as such, and come to the surface only after traveling a relatively great distance. Porosity, effective size, and uniformity coefficient have little influence on upward pressure exerted against floor of dam. Piling at heel of dam reduces the pressure on the floor, and piling at toe increases it. Piling at heel of dam, to be effective, must be tight, very small leakage destroying its action. Piling at toe of dam should be loose, in order to prevent increasing upward pressure on floor of structure. An impervious cut-off wall of comparatively shallow depth, say, 5 ft., at heel of structure, will greatly increase its stability by reducing the upward pressure on the floor.

Upward Pressure Test Pipes Constructed in Concrete.
(*Engineering News-Record*, Vol. 82, 1919, p. 954.) Describes an installation of pipes to measure upward pressure in Brule River Dam of Peninsular Power Company of Wisconsin, Messrs. D. W. Mead and Charles V. Seastone, Engineers. The dam is 70 ft. high, base width, 48½ ft., top width, 6 ft., working head, 60 ft. Under-drainage is provided through a 12-ft. vitrified tile drain running longitudinally with dam, to which are connected, at intervals of 20 ft., 12-in. lateral drains. Test apparatus consists of 1-in. iron pipes placed vertically and extending from the bed to a height above tail-water where each turns

and runs horizontally to pierce the down-stream face of the dam. At the bottom of each pipe a cone-shaped metal collector is attached. Three pipes, one in the up-stream cut-off wall trench, one, 6 ft., and one, 18 ft., down stream, are placed to measure the upward pressure. Observations of the pressures had not been made at the time of publication of the article.

Study of Pressures in Hydraulic Dams.

(*Engineering News-Record*, Vol. 83, 1919, p. 1040.) Methods of Miami Conservancy District with measurements on Germantown Dam. Describes the use of the Goldbeck cell for measuring internal pressures.

Experiments Made on Island Park Dam, Dayton, Ohio.

(*Engineering News-Record*, Vol. 84, 1920, p. 1014.) A system of 1-in. pipes was installed in an overfall type of dam about 10 ft. high. Observations on pipes have been made, but the inferences to be drawn are not clear. Line of creep theory was not substantiated in this investigation. Experiment indicates that sheet-piling and cut-off walls are valuable in reducing upward pressure. If methane gas is formed under a dam it is a potential source of danger if the dam is shaped so as to retain the gas.

IV.—Losses in Siphon Spillways

Siphon Spillways on the Glens Falls Feeder, New York State Barge Canal.

(*Engineering News*, February 12, 1914.) Gives design for spillway discharging 70 sec-ft. and results of tests showing 61% efficiency.

Dam and Tunnel Construction of Marin Water District.

(*Engineering and Contracting*, September 10, 1919, Staff article.) Refers to the Marin Municipal Water District, Marin County, California. Description of siphon spillway is of interest.

Spillways for Reservoirs and Canals.

A. T. Mitchelson. (*Bulletin 831*, U. S. Dept. of Agriculture, 1920.) Siphon spillways discussed on pp. 15–38. Reference is made to tests conducted by Throop College of Technology of California and to similar tests by U. S. Bureau of Public Roads at Fort Collins, Colo., using models. The results of tests in regard to loss of head were not consistent, but were sufficiently accurate to warrant the use of standard formulas until more reliable data can be developed.

Siphon Spillways.

G. F. Stickney. (*Transactions*, Am. Soc. C. E., Vol. LXXXV (1922), p. 1098.) In the discussions on this paper, Robert E. Horton, M. Am. Soc. C. E., states that head losses in automatic siphons may be considered in three parts: (*a*) Entry head; (*b*) bend loss; and (c) pipe friction in the siphon leg. The precise law of relation of shock loss to radius of bend is not known, but it may be assumed to be some function, $f(r)$, of radius of bend. W. P. Creager, M. Am. Soc. C. E., in his discussion of this paper, and as an example indicating the application of the siphon, derives several equations for loss of head in various parts of the siphon.

V.—Silt Problems

Report on the Mississippi River.

Humphreys and Abbot. (1861.) Sediment measurement by the Delta Survey. Quotes various authorities as to silt contents of European rivers.

The Suspension of Solids in Flowing Water.

E. H. Hooker. (*Transactions*, Am. Soc. C. E., Vol. XXXVI (1896), p. 239.) A symposium of data on transporting velocities of water to date of this article. Excellent as starting point for literature on this subject.

The Silting Up of Lake McDonald and the Leak at the Austin Dam.

T. U. Taylor. (*Engineering News*, February 22, 1900, p. 135.) Comments on pp. 161, 179, 212, 410. In 7 years silted 48% of capacity. Sand extended 2 miles below upper end of shoestring-shaped reservoir. Law of silting, $d = h\,(1 - [1 - x]\ n)$, in which d is depth deposited in n years, in feet; x is depth, in feet, of silt deposit by each foot in height per year; h is original depth of water.

Kennedy's Laws of Silting.

An Editorial Letter. (*Engineering News-Record*, Vol. 65, p. 701, June 8, 1911.) Quotes Kennedy law, $V_0 = Cd^m$, in which V_0 is the mean velocity under which there will be neither silting nor scouring; d is depth of water, in feet; m is a constant, 0.64, and C varies, being, for light sandy silt, 0.82, for coarser silt, 0.90, for sandy loam, 0.99, and for coarse silt, 1.07.

Cleaning a Large Settling Reservoir at Cincinnati.

J. W. Ellms. (*Engineering Record*, Vol. 67, pp. 689–691, June 21, 1913.) Using fire hose in concrete-lined reservoir the cost of removal of silt was: Labor, $0.0267; supplies, $0.0107; power, $0.0037; value of water used in cleaning, $0.0015; value of water wasted in draining, $0.0044; total $0.047. Cost per 1 000 000 gal. settled, $0.056.

Egyptian Irrigation.

Sir W. Willcocks and J. I. Craig. (Third Edition, Vol. 2, p. 542, 1913.) Gives analysis of actions at curves showing how silts are deposited and how eroded.

Silt in the Rio Grande.

W. W. Follett. (*Engineering News*, January 1, 1914, p. 18.) Gives historical outline of silt determinations begun in 1889 and analyzes all data gathered to 1912; also determined weight of 1 cu. ft. of silt to be 53 lb. This is abstract of Follett's report to the International Boundary Commission, published as a report of the Department of State in 1913. 53 lb. of dry silt to 1 cu. ft. of space filled.

Maintenance Excavator at Orland Reclamation Project in California.

(*Engineering Record*, Vol. 69, No. 15, p. 428, April 11, 1914.) Photographs and description of "Stockton" A-frame dredge, used to travel through and clean channels to head-gates and

gravel-filled canals. Total cost of dredge, $2 646. Dredge also used as pile-driver for trestle to carry itself from creek to canal bank, and *vice versa*.

The Use of Irrigation Water and Irrigation Practice.

B. A. Etcheverry. (Vol. II, p. 88; Vol. III, p. 87.) Not adaptable for synopsis. Quotes much data on silt in canals in India and in the United States. Gives conversion factors between percentage by weight and by volume where given in original data.

Locomotive Crane Mounted on Boat to Clean Irrigation Ditches.

(*Engineering Record*, Vol. 72, No. 10, 1915.) Shows photograph and gives elements of machinery for use in dredging canals of Minidoka Project.

Silt Problem in Imperial Valley System.

J. C. Allison. (*Engineering Record*, Vol. 73, Feb. 5, 1916, p. 182.) In 1914, 30 024 000 cu. yd. of solid matter entered canals from the Colorado River (of West). This equals 18 610 acre-ft. Of this, 1 511 000 cu. yd. were dredged at cost of 12½ cents per cu. yd. Considering amount cleaned by mutual companies besides the above, leaves 26 000 000 cu. yd. to be carried on to lands, into Salton Sea by waste water, or to accumulate in canal systems. The valley spends about $1 000 000 per year in ridding itself only partly of silt.

Solids a Problem at Power Plants in Northwest.

John Harisberger. (*Engineering Record*, Vol. 74, No. 10, p. 290, September 2, 1916.) Describes silts and gravels from glacial-water streams; gives methods used to eliminate gravels, then sands. None given for removal of colloidal silts that do not settle in reasonable time. States small suction dredge of 5 sec-ft. capacity will remove from 6 to 10% of sand and silt from a basin where gravity or pressure water is not available for sluicing.

Studies of Character and Rate of Silting of Elephant Butte Reservoir.

Victor E. Lieb. (*Reclamation Record*, September, 1916.) Shows that fine silt is a red ooze that is not finally deposited except by evaporation and then weighs 94 lb. per cu. ft. Deduces life of Elephant Butte Reservoir to be 23 years.

California Reservoirs Silt Up Slowly.

E. Bowen. (*Engineering News-Record*, Vol. 79, pp. 169–170, July 26, 1917.) Sweetwater Reservoir silted 4% of its capacity in 12 years. Lake Cabot silted 16½% of its capacity in 36 years. Space above La Grange Dam silted 54.2% of its capacity in 10 years. (Note: Refers to La Grange Reservoir. La Grange Dam is a high diversion dam and no account is taken or needed of the space capacity above it.)

Silt Observations at Yuma Gauging Station.

L. M. Lawson. (*Reclamation Record*, Vol. 8, No. 5, p. 240, 1917.) Station on Colorado River (of West). Maximum percentage of silt by weight 4.16 and mean percentage, 0.70. Weight per cubic foot of wet deposit, 86 lb.; weight per cubic foot of solid dried, 159.3 lb.; specific gravity, 2.6.

— Abstract. (*Engineering Record*, Vol. 74, p. 406, and *Engineering and Contracting*, Vol. 47, p. 437.)

Silt Problem of Zuni Reservoir.

H. F. Robinson. (*Transactions*, Am. Soc. C. E., Vol. LXXXIII (1919–20), pp. 868–893.) Discussion by Elwood Mead, *et al.* Shows 60.7% of storage space lost in 12½ years. Gives remedial measures; detention dams along watercourse; enlargement of reservoir; suction dredge drawing on silt bottom and discharging through one of the dam openings. Speaks of large bank storage in coarse talus slopes or morains and smaller storage in fine silt deposits.

— Abstract. (*Engineering and Contracting*, Vol. 52, pp. 294–295, September 10, 1919.) Gives data regarding silting up of Zuni Reservoir, New Mexico; discusses silt deposits from Southwestern streams, quantities of water carried by streams, and remedial measures suggested. In 12½ years, 4.86% of space silted. Of 326 648 acre-ft. space, 5 507 acre-ft. silt in addition to 1.88% carried through reservoir. Estimates life of reservoir as 32.4 years.

Movement of Silt, Elephant Butte Reservoir.

L. M. Lawson. (*Reclamation Record*, September, 1919, p. 411.) Silt 1 to 7% by weight estimated carried out through lower end of Elephant Butte Reservoir. Sealed ditches as far as 160 miles. Surface of reservoir clear through this period. Evidently silt rolling and suspended near bottom of reservoir. Muddy waters entering reservoir at this time.

Sand Sluicing Operations, West Extension Umatilla Project.

H. M. Schilling. (*Reclamation Record*, September, 1919.) Blow sand silted many miles of canals. Tried many methods of eradication. Final and best; made traveling templet 6 in. smaller than water prism, with vertical slot in center. Inclined templet with bottom up stream; concentrating velocity under and through templet moving sand down stream. One man operates moving templet down stream as it completes work in one place.

— Abstract. (*Engineering and Contracting*, November 12, 1919.)

Devices for Scouring Silt from Irrigation Canals.

F. R. Smith. (*Reclamation Record*, August, 1920.) Described success obtained with an A-shaped crowder, weighted with rocks; placed in canal; scour undercuts it—then moved down stream and placed again—carrying silt and sand down stream.

Sand Removed from Ditch by Scouring.

(*Engineering News-Record*, Vol. 85, 1920, p. 707.) Describes a wooden device shaped like the letter, A, which is placed in canal with vertex down stream and the legs are anchored to the bank by means of ropes. Stones weight down the frame which induces scouring by water flowing underneath at a higher velocity. As the scouring progresses the frame settles until the desired depth is reached when it is moved down stream and the process repeated.

Ditch Design for Prevention of Silt Deposit.

Abstract of paper by Q. O. Ayres. (*Engineering News-Record*, Vol. 86, 1920, p. 647.) The silt-carrying capacity of the stream was derived from the upward component of the velocity of eddies. These depend on high velocity and shallow depth, therefore the silt capacity depends on the velocity and depth. To prevent silting, the relation of the velocity

and the depth must be kept in constant ratio, the velocity being not too great to produce scouring and not too slow to allow deposit. This can be accomplished by changing the width of the canal. A definition of critical velocity is the velocity high enough to prevent silting and low enough to prevent scouring, that varies with the depth, but is independent of the width. The formula expressing the relation between critical velocity and depth, is $V = CD^m$ V is the critical velocity, in feet per second; D is the correct depth, in feet; C and M are experimental constants. Mr. R. G. Kennedy found values of C as 0.84 and 0.64 on canals of various sizes in India, which have reached a condition of silt equilibrium. Further supporting investigations of the formula are needed. Gives a table of the "critical velocities of ditches."

Operator's Viewpoint of Canal and Structure Design.
George Ebner. (*Engineering News-Record*, Vol. 89, 1922, p. 1116.) Gives an operator's viewpoint on silt problems.

Siltation of Austin and Lake Worth Reservoirs in Texas.
John B. Hawley. (*Engineering News-Record*, Vol. 91, 1923, No. 20, p. 811.) Defends some statements made by T. U. Taylor, M. Am. Soc., C. E., on the Austin Dam in *Engineering News-Record*, Vol. 91, No. 10. Gives a comparison between two lakes to show that reservoir construction in Texas is practicable.

Reservoir Losses 84% of Storage Capacity in Nine Years.
T. U. Taylor. (*Engineering News-Record*, Vol. 91, 1923, No. 10, p. 380.) Measurements show silting of reservoir made by dam across Colorado River at Austin, Tex., decreased the storage capacity 83.84% during 9 years ending in summer of 1922, compared to 62% behind first dam in 4 years ending May, 1897, and 52% for 6¾ years from May, 1893, to January, 1900. Formula for rate of silting in terms of the depth on a base of 1 sq. mile (derived in *Engineering News*, February 22, 1900, p. 135), $h\ (1 - x)^n$ = depth of water after n years; h = foot depth on a basis of 1 sq. mile; x = percentage silt deposit each year on an average; and h = number of years. (Note: The remainder of the article tells of the floods on this river for the years 1843, 1852, 1869, 1870, 1899, 1900, and 1913. Also tells of low points for the years 1910 and 1918.)

Silt and Silting Basins on Drainage Works.
Abstract of paper read before the National Drainage Congress by Roy N. Towl. (*Engineering News-Record*, Vol. 92, 1924, No. 12, p. 488.) Defends settling basins for drainage areas to protect ditches from silt deposit.

Methods of Overcoming Silting of Reservoirs.
(*Engineering News-Record*, Vol. 93, 1924, No. 8, p. 306.) Gives the advantage and disadvantage of each of the following methods: (1) Pumping by floating dredge; (2) sluicing through openings in dam; (3) blasting in time of flood; (4) evacuation by dragline scrapers.

VI.—Chutes and Drops

Typical Inclined Drop for Irrigation Canal.
U. S. Reclamation Service Staff Article. (*Engineering and Contracting*, May 6, 1914, p. 537.) Milk River Project. Numerous sketches.

Method and Cost of Constructing Reinforced Concrete Drops.
Robert S. Stockton. (*Engineering and Contracting*, April 14, 1915.) General methods used by Canadian Pacific Railway irrigation projects.

Stopping Sink Holes in Irrigation Canals and Construction of Drops in Light Soils.
C. J. Moody. (*Engineering and Contracting*, September 8, 1920.) General discussion of methods used.

Hydraulics of the Intake to a Pipe Drop.
George Henry Lewis. (*Engineering News-Record*, Vol. 85, 1920, p. 565.) Describes the Pishkun pipe drop on the Sun River Project of the U. S. Reclamation Service, which is used as a measuring station. A graph giving the relation between discharge and head of water of sill of drop is given.

VII.—Scouring Below Dams

The Reconstruction of Big Hole Dam, Montana.
Joseph H. Harper. (*Journal*, Assoc. of Eng. Societies, Vol. 24, p. 239, April, 1900.) Describes methods used in rebuilding a high timber crib dam that partly failed.

The Reconstructed Canyon Ferry Dam near Helena, Montana.
(*Engineering News*, April 26, 1900.) Describes additions and reinforcements to original structure.

Reconstruction of the Elwha River Dam.
V. H. Reineking. (*Engineering Record*, March 28, 1914.) Account of placing new foundation under washed out dam.

Uplift from Hydraulic Jump Neglected in Dams on Porous Foundations.
E. W. Lane. (*Engineering News-Record*, Vol. 80, p. 831, April 25, 1918.) Calls attention to failures of dams caused by the upward pressure on aprons due to hydraulic jump.

The Record of 100 Dam Failures.
Lars Jorgensen. (*Journal of Electricity*, Vol. 44, March 15, and April 1, 1920.) Gives dates, locations, descriptions, and reasons for failures. Included in these are several which failed because of undermining.

Floods Wash Out Part of Apron of Granite Reef Dam.
(*Engineering News-Record*, Vol. 84, 1920, p. 355.) Describes damage to down-stream apron of this dam on the Salt River Project, which occurred in 1919 for the second time.

Foundation of dam is said not to be rock. Height of cut-off wall is 20 ft. 0 in. Height of dam crest to this wall is 35 ft., 0 in. Width of dam proper is 21 ft., 0 in. Material is concrete. An apron, 75 ft., 0 in. long, extends down stream from toe of dam. This is 1.5 ft. concrete pavement which is laid over 4.5 ft. of boulders. At the down-stream end there is a rectangular concrete wall 12 ft. deep and 4 ft. thick, the top of which is flush with the top of the pavement. With a depth of 7.65 ft. on the crest, and a flood of 100 000 sec-ft., the pavement was taken out for its full width of 75 ft. over a length of 540 ft., its total length being (like the dam) 1 000 ft. In addition to the concrete pavement the boulders were also washed out full depth and a part of the toe-wall had to be replaced. Another flood in 1920, which produced a depth of 8.0 ft. on the crest, did no damage.

Repairing the Spillway to Gibraltar Dam.

R. A. Hill. (*Engineering News-Record*, Vol. 89, November 9, 1922.) Gives details of repairs to water supply dam for Santa Barbara, Calif.

VIII.—Measuring Irrigation Deliveries

Experiments on the Discharge of Water of Different Temperatures.

John George Mair. (*Minutes of Proceedings*, Inst. C. E., Vol. LXXXIV, p. 424, 1886.) For sharp-edged orifice, 2½ in. in diameter;

Head, in inches.	Temperature, in degrees.	Coefficient, *C*.
21	57	0.604
21	92	0.604
21	110	0.604
21	153.5	0.607
21	179	0.607

For about the same range of temperature, the coefficient of velocity increased from 0.961 at 55° to 0.981 at 170 degrees. Results given on discharge through pipes.

Measurement and Division of Water.

L. G. Carpenter. (Colorado Experiment Station, *Bulletin 13*, 1890.) Divisor and modules, historical. The Foote module and spill-box. Discussion of weirs with tables; heads recorded to a minimum of 0.3 in., or 0.25 ft., and a discharge of 0.0135 sec-ft. for a 1-ft. trapezoidal weir.

Measurement and Division of Water.

L. G. Carpenter. (Colorado Experiment Station, *Bulletin 27*, 1894.) Historical discussion of divisor and modules. Notes of apparatus being invented that have a constant discharge. Spill-box or excess weir. Weirs and discharge tables.

Report of Irrigation Investigations for 1900.

(U. S. Dept. of Agriculture, *Bulletin 104*, No. 3, 1900.) Discussion and illustrations of weirs, dividing boxes, and other devices used in irrigation.

Report of Irrigation Investigations for 1901.

(U. S. Dept. of Agriculture, *Bulletin 119*, 1902.) Contains results of measurements of irrigation water in canals and farm laterals throughout arid region.

Farmers' Weirs.

S. Fortier. (Montana Agricultural Experiment Station, *Bulletin 34*, 1902.) Definitions: Miner's inch box objectional. Irrigation water should be measured; how and where to place weir boxes. Plans and bill of material for weir boxes for crest lengths 12, 18, 24, 36, and 72 in. Weir gauges and discharge tables. Instructions as to how to measure water over weirs. The discharge tables for the rectangular weir are given in Montana miner's inches, while the discharge of the Cippoletti weir is given in second-feet.

Report of Irrigation Investigations for 1902.

(U. S. Dept. of Agriculture, *Bulletin 133*, 1903.) Contains description of methods used in measuring water and results.

Irrigation in Montana.

Samuel Fortier. (U. S. Dept. of Agriculture, *Bulletin 172*, 1906.) Discusses units of measurements, how measurements were made, and gives the quantities of water applied to land under typical canals.

Weirs for Irrigation Streams.

G. E. P. Smith. (Arizona Experiment Station, *Bulletin 54*, 1906.) Reasons for measuring irrigation streams; devices, weir boards, weir boxes. How to determine discharge. (Note: In same *Bulletin*, p. 105, is a table of discharge from a ¾-in. pipe with sets of orifices of different diameter. Head, 16 to 20 ft., orifices, 5/32 to 9/32 in. in diameter; discharge, in gallons per hour.)

Weir Experiments, Coefficients and Formulas.

R. E. Horton. (U. S. Geological Survey, *Water Supply Paper No. 200*, 1907.) Definition of terms used. Elementary deduction of weir formulas. Theory of weir measurements. The influence of velocity of approach on discharge. Thin-edged weirs. Comparison of different formulas; different types of weirs; discussion of weir-gauging methods. Results of experiments on various forms of weir cross-sections. Description of Cornell Laboratory arranged for weir experiments. Flow over weirs with broad crests. Results of the varying of the down-stream and up-stream apron or slope inclination. Dams of ogee cross-section and results of experiments on actual dams. Discussion of submerged weirs. Weir discharge under a varying head. Tables for determining weir discharges.

Measurement of Water.

E. Tappan Tannatt and R. D. Kneale. (Montana Experiment Station, *Bulletin 72*, 1908.) Discussion of units of measure. Weirs and dimensions of boxes up to crest length of 15 ft. Rating flumes. Discharge tables and fourteen plates.

Irrigation in the Sacramento Valley, California.
Samuel Fortier. (U. S. Dept. of Agriculture, *Bulletin 207*, 1909.) Brief reference to measurement of water delivered to land under the Moore ditch occurs on pp. 41-43.

Experiments on Small Weirs and Measuring Modules.
J. C. Stevens. (*Engineering News*, August 8, 1910.) Gives methods and results of calibration of weirs used on Sunnyside Project, Washington. There is also included a very simple diagram for submerged weirs in which coefficients are given to apply to free-flow conditions for various degrees of submergence.

Delivery of Water to Irrigators.
Frank Adams. (U. S. Dept. of Agriculture, *Bulletin 229*, 1910.) Gage Canal Company measuring devices. Modesto measuring devices. Bear River measurements. Truckee-Carson Project measurements. Summary of measurement of water and devices in use (p. 98).

Hydrometry as an Aid to the Successful Operation of an Irrigation System.
J. C. Stevens. (*Transactions*, Am. Soc. C. E., Vol. LXXI (1911), p. 314.) Outlines methods used on Sunnyside Project, Washington, with results secured in 1909. A particular type of trapezoidal weir was calibrated by volumetric measurements. Deals more with the administrative side of this subject than with any particular method of measuring.

The Use of Underground Water for Irrigation at Pomona, California.
C. E. Tait. (U. S. Dept. of Agriculture, *Bulletin 236*, 1911.) The methods of measuring pumped water near Pomona, Calif., are described on pp. 64 and 65.

Measurement and Division of Water.
L. G. Carpenter. (Colorado Experiment Station, *Bulletin 150*, 1911.) First twelve pages are descriptive and historical. Divisors; time method of division; modules; weir modules. Discussion of Francis and Cippoletti weir formula; submerged weirs; triangular weir or notch. Rating flumes; application of Kutter's formula. Discharge table; second-feet over weirs, 1 in. long. Discharge table, second-feet over weirs 1 ft. long. Cippoletti and rectangular weir tables to 10-ft. crests.

Measurement and Distribution of Irrigation Water.
L. M. Winsor. (Utah Experiment Station, *Circular 6*, 1912.) Requirements for the construction and installation of weirs. Depth of notch to length of crest. Division of water, adjustable dividers. Diverting a constant quantity of water (automatic weir module). Definitions and hints which will be of advantage to the irrigator. Discharge tables for weirs.

Selling Irrigation Water by Current Meters.
(*Engineering News*, January 9, 1913.) Editorial: Current meters used daily on main-line canals of California Development Company cause demand for hydrographers and engineers. Two facts brought out are overcoming of opposition to current meters, and putting once bankrupt property on a paying basis for the accurate measurement of water.

A New Module or Constant Discharge Device for Irrigation Works.
A. Shirra Gibb. (*Engineering News*, March 13, 1913.) An irrigation module without moving parts. Consists of series of obstructing plates, rectangular in section and circular in plan. The baffle-plates serve to destroy the head in excess of what is needed to give desired volume. Detailed description of device given. The merits of device are: Cannot be tampered with; silt or other matter cannot interfere with operation. Device in actual use in India.

Measuring Devices, Irrigation.
B. A. Etcheverry. (*Journal of Electricity*, Vol. 31, No. 3, p. 68; No. 4, p. 90, 1913.) Describes the use of rating flumes, weirs, a weir-box and take-out from pipe line under pressure, a miner's inch board or box, and submerged orifices for the measurement of irrigation water.

Experiments in Weir Discharge.
W. G. Steward and J. S. Longwell. (*Transactions*, Am. Soc. C. E., Vol. LXXVI (1913), p. 1045.) Discussion of experiments in rectangular and Cippoletti weirs, 6 to 36 in. in length; shows deviation of actual measured discharge from that computed by the Cippoletti and Francis formula, the error increasing with the head for both types of weirs.

Standard Measuring Weir, C. P. R. R. Irrigation Project.
(*Engineering Record*, June 28, 1913.) Specifications for constructing weir given. Feature of structure is the indicating plate placed at the level of crest and graduated to indicate flow in cubic feet per second.

Measurement of Water.
R. D. Kneale. (Montana Agricultural Experiment Station, *Circular 24*, 1913.) Units of measure; weirs and discharge tables (Cippoletti weirs only); tables both in second-feet and miners' inches. Adjustable Cippoletti weir. Concrete weir; describes only concrete bulkhead containing weir plate, no protection above or below. Rules for setting weirs, causes affecting accuracy of measurement, velocity of approach, incorrectly placed weirs. Submerged weirs, Kutter's formula and coefficients; float method of gauging streams; discharge through orifices, where the flow is proportional to length of conduit. Rating flumes, current meters. Illustrations not good being the same as those used in *Bulletin 72*, issued in 1908, by Montana Agricultural Experiment Station.

Proportional Flow Weir.
E. W. Rettger. (*Engineering News*, June 25, 1914.) Author finds that a weir the width of which at any point is inversely proportional to the square root of the height of that point above the crest, will have a theoretical discharge exactly proportional to the head. As the coefficient of actual divided by theoretical discharge is likely to have different values for different heads, the theoretical shape must be modified, in order to make the actual discharge directly proportional to the head. The author gives a process of making this adjustment.

An Automatic Head-gate for Regulation of Irrigation Flow.
Gilder and Lincoln. (*Engineering News*, March 5, 1914.) Constant flow is maintained by varying the area of a submerged orifice corresponding to a change in head such that

the area by the velocity is constant. Adjustment of orifice is made by a shutter-gate. Th cam was designed to vary the height of the orifice in the exact inverse ratio of the squa root of the head. Size of orifice can be adjusted by horizontal sliding plates. Device a tested had a capacity of 2.61 sec-ft.

Measurement of Stream Flow by Approved Weirs.

R. R. Lyman. (*Transactions*, Cornell Soc. C. E., Vol. 77, 1914, p. 1189.) Complet discussion of weirs without end contractions, broad-crested weirs, sharp-crested weirs, irregu lar-crested weirs. Tables, diagrams, and dimensioned elevations of large broad-crest weirs tested at the Cornell Hydraulic Laboratory.

Some Measuring Devices Used in the Delivery of Irrigation Water.

(California Experiment Station, *Bulletin 247*, 1915, California agents of Irrigatio Investigation, Office of Experiment Stations, U. S. Dept. of Agriculture.) Description o various kinds of orifices, weirs and mechanical registering devices. Discharge tables an coefficients.

Irrigation in Spain—Regulations Controlling the Use of Water, Metering Water for Irrigatio and Methods of Charging.

J. C. Stevens. (International Engineering Congress, 1915, *Waterways and Irrigatio Paper 45*, p. 657.) Describes methods of measuring water on the Urgel Canal and th Canal de Aragon y Cataluña. On the latter system the pay-for-what-is-consumed principl is followed exclusively.

Hanna Irrigation Flow Meter.

F. W. Hanna. (*Engineering News*, April 1, 1915.) Water for registering flow in rate canals and over standard weirs. Consists of counterweighted float in stilling-box. Tap runs over pulley in the meter. The pulley-shaft carries cam, the outline of which is deter mined by the rating curve of device on which it is to be used. This cam moves a pivote frame carrying a cylinder. The cylinder changes its point of contact on a spherical disk independent of pivoted frame, according to the height of water or flow. The disk i revolved by clock at a varying speed dependent on the point of contact. The revolution of the cylinder are recorded in acre-feet.

Tests of Submerged Orifice Head-Gates, etc.

F. L. Bixby. (New Mexico Experiment Station, *Bulletin 97*, 1915.) Tests on 1.5, 2 and 3-ft. submerged rectangular orifice. Calibration by volumetric method; method of deriva tion of formula; discharge tables and summary.

Irrigation Weir, Measuring Rod and Discharge Card.

Kenneth A. Heron. (*Engineering News*, August 5, 1915.) Distributing structures of timber. Checks consist of two or more weirs about 3½ ft. in length, constructed on a down-stream slope of 35 to 45° from the vertical. Heads on weirs measured by unique method. Suppressed end contractions. Weirs checked with current-meter measurements. Method has advantages over vertical weirs as a separate structure is not required.

The Dethridge Meter.

V. M. Cone. (Colorado Experiment Station, *Bulletin 215*, 1915.) The Dethridge meter is an integrating device for measuring flowing water. Meter has many points of advantage. Flow proportional to revolutions of meter within practical limits. Normal capacities of 4, 5, and 6-ft. wheels, respectively, are 0.75 to 2.5 sec-ft.; 1 to 4 sec-ft., and 1 to 8 sec-ft. Used extensively in Australia, but not common in this country.

Colorado Statute Inch and Some Miners' Inch Measuring Devices.

V. M. Cone. (Colorado Experiment Station, *Bulletin 207*, 1915.) Results of tests on small orifices. Determination of the relation of miners' inches to second-feet. Results of tests on the Uncompahgre orifice and Azusa hydrant. No fixed relation was found between miners' inches and second-feet for various sized small orifices.

Computing the Hydraulic Jump.

Karl R. Kennison. (*Engineering News*, December 7, 1916, p. 1096.) Error is made in not allowing for the creation and maintenance of velocity at flume entrances and outlets. There are two distinct conditions of flow. There is such a thing as the open Venturi. The hydraulic jump caused by one of the conditions of flow, the height of which represents velocity head regained. Formulas and discussion of equations given. Usually count on about one-half the "theoretic height of jump". Smooth obstruction might assist in forming the jump.

Experiments on the Economical Use of Irrigation Water in Idaho.

Don H. Bark. (U. S. Dept. of Agriculture, *Bulletin 339*, 1916.) Gives results of the measurement of water on a large number of farms in Southern Idaho. Methods of measurement are described.

Practical Methods of Measuring Flowing Water.

C. O. Wisler. (*Engineering and Contracting*, Vol. 45, 1916, p. 536.) The object of this paper is to give a brief résumé of the different methods commonly used in the measurement of flowing water, drawing attention to those purposes for which each method is best adapted, and, finally, discussing in more or less detail some of the most important methods used in flow measurements.

Flow Through Weir Notches with Thin Edges and Full Contractions.

V. M. Cone. (*Journal of Agricultural Research*, Vol. V, No. 23, 1916.) Detailed study of the calibration of Cippoletti and rectangular weirs to a length of 4 ft. and also notch and circular weirs. Comparison of data with the Francis formula. Effects of contractions and submergence. Diagrams and discharge tables.

A New Irrigation Weir.

V. M. Cone. (*Journal of Agricultural Research*, Vol. V, No. 24, 1916.) This device consists of a long diverging approach section, no bottom contraction, and partly suppressed side contraction. The discharge is materially greater than for a full contracted rectangular weir of equal length. This device is self-cleaning, reasonably accurate, and simple to construct. The results of the experiments, specifications for construction and use of this new device, as well as discharge tables and favorable comments are given.

The Venturi Flume.

V. M. Cone. (*Journal of Agricultural Research*, Vol. IX, No. 4, 1917.) Describes the Venturi flume as designed by the author, its adaptability for measuring irrigation water, and gives discharge curves and tables.

Construction and Use of Farm Weirs.

V. M. Cone. (U. S. Dept. of Agriculture, *Farmers' Bulletin 813*, 1917.) Practical suggestions as to the installation and use of small farm weirs. Definitions, advantages and disadvantages of weirs, crests, gauges, discharge tables.

Divisors.

V. M. Cone. (Colorado Experiment Station, *Bulletin 228*, 1917.) Table of results of experiments on divisors of various forms. Discharges limited to about 10 sec-ft. In general, the tests show a rather wide variation of the proportionality of the flow when based on the same proportional opening of divisor to width of channel. Head has much to do with the division of flow.

Flow Through Submerged Rectangular Orifices with Modified Contractions.

V. M. Cone. (*Journal of Agricultural Research*, Vol. IX, No. 4, 1917.) Report of tests on submerged rectangular orifices with and without bottom contraction, the bottom contraction consisting of 1⅝-in. angle-iron. The side contractions were of various dimensions. Coefficient of discharge varies between 0.60 and 0.72. Gate-guides projecting from the plane of the face of the orifice increase the discharge. Discharge tables given for standard condition.

Measurement of Water to Farms, Methods, etc.

J. S. Longwell. (*Reclamation Record*, No. 10, 1918.) Of interest to both the engineer and water user.

Methods of Measuring Irrigation Water Deliveries to Farms.

J. S. Longwell. (*Engineering and Contracting*, Vol. 50, p. 163, November 13, 1918.) Measurements by floats are occasionally made. The more common methods are by rating flumes, head-gates, weirs, submerged orifices, Venturi flume, Venturi meter, and Dethridge meter, each of which method is briefly described.

Practical Information on the Measurement of Irrigation Water.

O. W. Israelsen. (Utah Experiment Station, *Circular 36*, 1919.) Weirs and discharge tables. Portable weirs. Lyman rectangular weir without end contractions and discharge table for 1-ft. length of crest. Submerged orifices. U. S. Reclamation Service, with tables. Division of water by use of weir.

Measuring and Recording Deliveries of Irrigation Water.

J. S. Longwell. (*Engineering and Contracting*, Vol. 51, p. 169, February 12, 1919.) D. C. Henny discusses limitations of accuracy, importance to the water user and to the project.

Combination Tap-Box and Measuring Device for Metering Irrigation Water.

(*Engineering and Contracting*, March 12, 1919. Staff Article.) A description of the Burnham submerged orifice.

The Accuracy of Water-Level Recorders and Indicators of the Float Type.

J. C. Stevens. (*Transactions*, Am. Soc. C. E., Vol. LXXXIII (1920), p. 894.) Where continuous records of flow are required some form of recorder is necessary operating in conjunction with a weir or other measuring structure. This paper analyzes the errors involved in the use of float-operated instruments. It shows that for ordinary field use the standard instruments are sufficiently accurate. A method of preparing correction diagrams is outlined for use where extreme accuracy is required.

A Stilling Rack for Weirs.

George S. Brinckley. (*Engineering News-Record*, Vol. 85, 1920, p. 558.) Describes a wooden rack used by the author to remove turbulence in water in a channel when it is desired to make weir measurements. Device recommended highly by the author.

A Study of the Venturi Flume as a Measuring Device in Open Channels.

P. S. Wilson and C. A. Wright. (*Engineering News-Record*, Vol. 85, p. 452, 1920.) Experiments with two different designs of rectangular Venturi flume conducted at Cornell University. Each flume had a throat width of 8 in., equal to one-third the width of the channel, and each converged in a distance of three throat widths and diverged in a distance of ten throat widths. It was found that the coefficient of the Venturi flume for any particular condition of flow within rather wide limits is a fixed determinable quantity close to unity.

An Improved Weir for Gauging in Open Channels.

Clemens Herschel. (*Mechanical Engineering*, Vol. 42, No. 2, pp. 83–88, 1920.) Results of a series of investigations on weirs conducted at Mass. Inst. Tech., in which an entirely new weir was devised. The tests revealed that for discharges from 0 to 9.55 cu. ft. per sec. per ft. of weir length, the quantity of water flowing, Q, was directly proportional to the difference, d, in two pressures, one measured just up stream of the weir and corrected automatically for the velocity of approach, and the other measured at the crest. The formula for this weir is $Q = 5.5\ d$.

The Herschel Weir for Gauging in Open Channels.

Clemens Herschel. (*Engineering News-Record*, April 8, 1920.) Abstract of article on Herschel weir. A circular hollow-crested weir giving a straight-line formula, based on differences in pressure above and at the crest, the first corrected automatically for velocity of approach. Details of experimental apparatus are shown. The separate sets of tests are given in detail. The straight-line formula is very convenient to handle.

The Venturi Flume.

R. L. Parshall and Carl Rohwer. (Colorado Experiment Station, *Bulletin 265*, 1921.) The Venturi flume giving discharge diagrams for flows up to 400 sec-ft. Practical suggestions as to installing and operation, loss of head, and experimental errors.

Measurement of Irrigation Water on the Farm.
H. A. Wadsworth. (California Experiment Station, *Circular 250*, 1922.) Units of measure and equivalents; weir and discharge tables; submerged orifices. Adjustable submerged orifices; Riverside miners' inch box. Anaheim Union Water Company's measuring box; Santa Ana Valley Irrigation Company's measuring box. Azusa hydrant; division boxes; mechanical devices for measuring water.

The Measurement of Water.
W. G. Steward. (Idaho Experiment Station, *Bulletin 127*, 1922.) Units of measurement defined. Construction of weirs; new idea in the construction to flush weir pond. Weir tables in miners' inches. Submerged weirs and connection diagram. Discharge table, submerged orifice based on $C = 0.62$ in miners' inch units. Poor illustrations.

Field Experiments on a Practical Irrigation Rating Box.
C. C. Jacob and H. R. Leach. (*Engineering News-Record*, March 30, 1922.) Note of Cone's "New Irrigation Weir", from which some of the data was taken. A number of boxes were installed in the Uintah Basin Project in the silt-laden canals with good results. Logarithmic plot of results discussed, showing the variation in slope for different sizes of boxes. Boxes replaced Cippoletti weirs which were impossible to maintain.

Water Measurements on Irrigation Project.
C. C. Cragin. (*Engineering and Contracting*, February, 1923, p. 406.) Reprint from *Reclamation Record*. Describes methods used by Salt River Valley Water User's Association which delivers water to 240 000 acres.

Discharge Measurements for the Control Section Weir.
J. L. Savage. (*Engineering News-Record*, Vol. 92, No. 20, 1924, p. 842.) New weir shows a remarkable check on theoretical rating curve. Theory of the weir is outlined in *Engineering News-Record* for December 20, 1920, p. 1223, by Julian Hinds, M. Am. Soc. C. E. Experiments were made by Allan L. Darr at Klamath Project, in Oregon, in the summer of 1922. This weir is superior to the sharp-crested weir and the Venturi flumes in several ways: (1) It requires less fall; (2) no pool is required above; (3) only one reading is necessary. It is taken with an ordinary weir gauge.

Open-End Flume Water Meter Based on Exponential Equation.
J. W. Ledoux. (*Engineering News-Record*, Vol. 93, No. 13, p. 505, September 25, 1924.) Gives experimental results on a 6-in. and 15-in. flume, about 15 ft. long, having rectangular cross-section, level floor, with and without open end. Theoretical formula for discharge is $Q = c\,h^n$. The head, h, is determined at various points, 18, 36, 54, and 120 in. from the lower end of the flume. Both c and n decrease as the distance from the end of flume increases and are both greater for the wider flume. "For rectangular channels an exponent, n, of about 1.7 is approximately correct for a wide range of widths." The coefficient, c, varies between rather wide limits. Author states that the device is suitable for irrigation purposes and does not have the limitations of a weir and requires less head. Experiments based on discharges of less than 1 sec-ft. Does not mention velocity of approach or silt troubles.

X.—Permissible Canal Velocities

The Flow of Water in Irrigation Channels.
Fred C. Scobey. (U. S. Dept. of Agriculture, *Bulletin 194*, 1915.) On pp. 19–27, data regarding a large number of irrigation canals, both lined and unlined, are given in tabular form, including the mean velocity, in feet per second. Velocities as high as 20 ft. per sec. were observed, this being in a concrete-lined wasteway.

Curves for Irrigation Ditch Velocity and Discharge.
L. R. Douglass. (*Engineering News*, Vol. 76, p. 72, July 13, 1916.) With regard to range of velocities where soil is mostly sandy loam, velocities of 1.5 to 2.5 ft. per sec. may be considered as limiting. This first is enough to prevent silting and the second is slightly below that which would cause erosion. Discussed by Julian Hinds, M. Am. Soc. C. E., *Engineering News*, August 24, 1916, p. 369, who presents another curve believed to be better.

Effect of Curvature Upon Flow in Open Channels.
H. P. Eddy. (*Engineering News-Record*, Vol. 87, 1921, p. 516.) Discussion of losses in open channels due to curvature. Brief review of experiments made and the conclusion drawn, that is, in the present estate of knowledge this loss must be taken care of by increasing the n in Kutter's formula by adding 0.003 to 0.005 to it for channels with considerable curvature for which n equals 0.025 on straight alignment.

Flow of Water in Steel Pipes

This subject was not one of those selected for research by the Special Committee on Irrigation Hydraulics, but a bibliography on the subject "Flow of Water in Steel Pipes" was submitted to the Committee by Fred C. Scobey, M. Am. Soc. C. E. It is a valuable addition to engineering knowledge on this subject, and, therefore, is included with the Committee's bibliography.

Flow of Water in Steel Pipes Under Pressure

The Flow of Water in Pipes Under Pressure.
C. G. Darrach. (*Transactions*, Am. Soc. C. E., Vol. VII (1878), p. 114.) Q by displacement of pumps with 5% deduction for slip. Data too voluminous for synopsis.

Experiments on the Flow of Water in a 48-Inch Pipe.
Frederic P. Stearns. (*Transactions*, Am. Soc. C. E., Vol. XIV (1885), p. 1.) Author's experiments on Rosemary Siphon, Boston, Mass., Hering and Trautwine (Kutter), p. 149. Q by weir 10 miles distant; n between 0.0105 and 0.0109; length, 1 757 ft.; V from 2.6 to 6.1 ft. per sec.

Hydraulics.
Hamilton Smith, Jr. About 1888. Quotes all known data (prior to writing): Iben-Darcy–Tubbs–Couplet–Ehmann.

Flowage Test of a 14-Inch Riveted Steel Main at New Westminster, B. C.
A. McL. Hawks. (*Engineering News*, Vol. XXXVI, 1896, pp. 76 and 90; Vol. XLII, 1899, pp. 4, 26, 89, 107.) Tests on 14-in. pipes at New Westminster, B. C. Found values of n about 0.013.

The Flow of Water in a 48-Inch Pipe.
R. Hering. (*Engineering Record*, February 15, 1896.) Discussion of FitzGerald paper before American Society of Civil Engineers; commends Chezy formula and asks complete data in presentation of any formula.

115 Experiments.
Clemens Herschel. John Wiley and Son, N. Y., 1897. Gives experimental data on riveted pipe up to 108 in. in diameter. Discusses in detail the "Rochester Crime", that is, the 1877 tests in Rochester, N. Y.

Final Report, Los Angeles Aqueduct.
(pp. 80-81.) In riveted steel pipes, quotes J. Waldo Smith, M. Am. Soc. C. E.; for 42-in. lines. Values of Chezy's, C from 89 to 109.

Report to Executive Board, Rochester, N. Y.
Emil Kuichling. 1897, pp. 40–42. Mentioned in Hughes and Safford's "Hydraulics"; also corrected in *Journal*, New England Water Works Assoc., Vol. 13, 1898, p. 138. On 38-in. pipes. Chezy's, C from 95 to 116 for V from 0.490 ft. per sec. to 1.25 ft. per sec. Found Q by rise in reservoir. $V = \frac{Q}{a}$.

The Origin of the Chezy Formula.
Clemens Herschel. (*Journal*, Assoc. of Eng. Societies, June, 1897.) Probably first time given American engineers. Translated from French.

Experiments on the Flow of Water in the Six-Foot Steel and Wood Pipe Line of the Pioneer Electric Power Company at Ogden, Utah.
Charles D. Marx, Charles B. Wing, and Leander M. Hoskins. (First Paper (with Discussion), *Transactions*, Am. Soc. C. E., Vol. XL (1898), p. 471; Supplementary Paper (with Discussion), Vol. XLIV (1900), p. 34.) Found values of n from 0.015 to 0.019 for 1899 tests and values of Chezy's, C, from about 90 to more than 120. Although apparently carefully done, these experiments show very erratic retardation factors, whatever the formula used.

The Flow of Water in a Six-Foot Conduit.
(*Engineering Record*, June 4, 1898.) Comment of experiments of Marx, Wing, and Hoskins, at Ogden, Utah.

The Flow of Water in Pipes.
C. H. Tutton. (*Journal*, Assoc. of Eng. Societies, October, 1899.) Analysis of experiments on various kinds of pipes convinces author that exponential formula with loss of head varying as something less than the square of the velocity is best.

Diagram Giving Discharge of Pipes by Kutter's Formula.
John H. Gregory. (*Engineering Record*, September 17, 1904.) Claims to be originator of diagram published by Professor Church of Cornell University.

Coolgardie (Australia) Water Supply.
C. S. R. Palmer. (*Minutes of Proceedings*, Inst. C. E., 1904–05, Paper 3516, p. 88.) Average resistance when new on 22-mile and 12-mile stretches 2.25 ft. per mile for 5 000 000 Imperial gal. per day and 2.8 ft. per mile for 5 600 000 Imperial gal.

Dredge Discharge Pipes; Riveted Steel.
F. B. Maltby. (*Transactions*, Am. Soc. C. E., Vol. LIV, Part C (1905), p. 443. Partly described in *Engineering News*, July 18, 1912.) On dredger pipes, 31 to 33 in., V from 14 to 22 ft. per sec.

An Outfall Sewer of Corrugated Pipe and Measurements of Its Internal Friction.
(*Engineering News*, No. 16, April 17, 1913, p. 774, probably from report of F. H. Todd, M. Am. Soc. C. E.) The computations are erroneous. Gives incorrect values of n.

Corrected data.				Data as published.	
V.	s.	n.	C.	L, in feet	n.
1.599	0.001435	0.0201	59.6	1037.8	0.0212 to 0.0222
1.581	0.001322	0.0196	61.5	"	
1.573	0.001558	0.0211	56.3	2807.8	Details not given
1.549	0.001547	0.0213	55.7	"	

First two on straight reach. Second two on reach including curve and same straight reach as before.

Water Flow in Wrought Iron Pipe (Screw Joints) at Morenci, Arizona.
W. L. Du Moulin. (*Transactions*, Am. Soc. C. E., Vol. LXXIX (1915), p. 1294.) Found value of C in Hazen-Williams formula of 123 for 10-in. pipe with V of 4.08 ft. per sec.

Flow of Water in Pipes (Steel Riveted).
H. Hawgood. (*Transactions*, Am. Soc. C. E., Vol. LXXVIII (1915), pp. 596–601.) On 8-in. pipe with V of 7.223 and fall of 170 ft. in distance of 4 354 ft., n computes 0.0114. On 10-in. pipe, with V of 4.689 ft. per sec. and fall of 110 ft. in 9 415 ft., n is 0.0116.

Roughness of Steel Pipe After 22 Years Service.

W. J. Reynolds. (*Engineering News*, November 9, 1916, p. 896.) Pipe of Glenwood Light and Power Company, Glenwood Springs, Colo. Test on 16 in. in outside diameter (15½ in. inside diameter). For V of 11.38 ft. per sec. found h_f equal to 20.61 per 1 000 ft. Reach, 6 229 ft., of which first 640 ft. was spiral riveted full diameter lap welded pipe, "very smooth". Found C (Hazen-Williams) equal to 144. Kutter's n equals 0.00938.

Carrying Capacity of Steel Pipe.

C. C. Kieth. (*Canadian Engineer*, August 24, 1919, p. 407.) Test 18-in. outside diameter (17½-in. inside diameter), steel tubing, with Custer steel coupling. For V of 2.67 ft. per sec. found H (per 1 000 ft.) equal to 0.651, giving value of C (Hazen-Williams) of 200. Something wrong with data as this should not exceed 150 for smoothest of pipes. Q by rise in reservoir. Reach 96 625 ft. long.

Pipe Line Velocities Necessary to Transport Gravel.

(*Engineering News-Record*, November 18, 1920, p. 988.) Velocity by path of trajectory of issuing stream. Likewise, V by Venturi. Check within 2 to 7 per cent. Slope by gauge at pump. V from 10 to 14 ft. per sec.

Progress Report of the Special Committee on Hydraulics Phenomena*

To the Board of Direction,
American Society of Civil Engineers:

Gentlemen.—The Committee has held one meeting during the year for the purpose of considering the plans for its work, and going over the results already obtained. It has also engaged in a voluminous correspondence.

The Committee feels that among the conditions that tend to hamper and limit the hydraulic research now being carried out by many different individuals in various locations scattered all over the United States, the following three are important:

First.—The lack of close contact among investigators with the resulting lack of that contagious enthusiasm and mutual interest which are so necessary to encourage and stimulate the worker to overcome difficulties and push a laborious undertaking forward to a successful conclusion.

Second.—A lack of experience and advisory direction with a consequent lack of advance appreciation of the difficulties that will have to be overcome in the course of an investigation.

Third.—Insufficient knowledge of work previously performed in the same field.

With the hope of lessening these obstacles the Committee has prepared a brief paper on the scope and distribution of current and recent research in hydraulics in the United States. This will enable any one contemplating or engaged on an investigation to know who else is working in the same field. Thus, workers may correspond with regard to the plans for their work and its progress, may avoid useless duplication, and may arrange for independent verification of results, a matter of great importance in most hydraulic work. Again, through this means, co-operative investigations may bring about more rapid progress.

The Committee has begun the preparation of a list of the names and locations of printed works on hydraulic subjects published before 1860 and now existing anywhere in this country. The completion and publication of this list will facilitate the consultation of these rare works by investigators.

The Committee has also undertaken to prepare evaluated digests of existing literature on a number of important topics, including: Water Hammer; Measurement of Water; Unsteady Flow in Open Channels; Flow in Pipes and Open Channels; Curved and Expanding Channels; and Recent Investigations of Nature of Fluids and Fluid Friction.

* Presented to the Annual Meeting, January 21, 1925.

Although the work is divided among the different members of the Committee, it is of such nature as to require personal attention and much time. It will take some years to complete what has already been planned.

Respectfully submitted,

S. M. WOODWARD, *Chairman,*
M. L. ENGER,
R. E. HORTON,
A. T. SAFFORD,
E. W. SCHODER.

November 21, 1924.

APPENDIX

THE SCOPE AND DISTRIBUTION OF CURRENT AND RECENT RESEARCH IN HYDRAULICS IN THE UNITED STATES

PREPARED BY
THE SPECIAL COMMITTEE ON HYDRAULICS PHENOMENA
OF THE AMERICAN SOCIETY OF CIVIL ENGINEERS, 1924.

The following list of research topics in hydraulics, accompanied by the names of active workers in each subject, has been prepared chiefly for two purposes:

First.—To enable different workers in similar or related lines to keep in touch with each other during the planning and progress of their researches.

Second.—To inform any engineer interested in some particular field where to apply to secure information regarding the most recent progress in that field.

Hydraulics touches on such a wide variety of topics that it has seemed best in this list to exclude in general the following fields: Hydrology, sanitary engineering, irrigation and drainage, and work with hydraulic machinery having only a limited commercial interest. This exclusion, however, does not extend to any detail which is usually recognized as belonging to the general subject of hydraulics.

Experimental work carried on by students in educational institutions is not included, except in cases where the results were sufficiently reliable, complete, and satisfactory as to justify publication. For such cases the topic is listed over the name of the instructor having charge of the work, except where the work showed unusual initiative and independence on the part of the experimenter.

To keep the number of topics conveniently small and to bring closely related subjects together, the headings used are to be understood as rather general in scope.

The list has been obtained by correspondence lasting nearly a year and involving hundreds of letters. Although all the laboratories named in Publication No. 5 of Engineering Foundation were addressed, as well as many names of individuals suggested from various sources, it can scarcely be hoped that the list is entirely complete. It is hoped that the number of omissions is small.

For those whose addresses are included in the 1924 Year Book of the Society, the names only are given; for others, whose addresses are given in the 1924 Year Book of the American Society of Mechanical Engineers, the names are followed by the letters, A. S. M. E. For those who are in neither of these classes, the names are followed by the full address.

Air-Lift Pump.—C. N. Ward, Madison, Wis.

Centrifugal Pumps.—R. L. Daugherty, A. S. M. E.; W. B. Gregory; L. F. Moody, A. S. M. E.; W. S. Pardoe; Allen F. Sherzer, Univ. of Michigan, Ann Arbor, Mich.; G. E. P. Smith; H. B. Taylor, A. S. M. E.

Current Meters.—C. M. Allen; R. L. Parshall.

Draft-Tubes.—C. M. Allen; R. L. Daugherty, A. S. M. E.; E. A. Dow; N. R. Gibson; L. F. Harza; L. F. Moody, A. S. M. E.; H. B. Taylor, A. S. M. E.

Effect of Temperature on Friction.—R. L. Daugherty, A. S. M. E.; Allen Hazen; F. E. Giesecke.

Flow in Improved and Artificial Channels.—H. K. Barrows; C. H. Eiffert; L. F. Harza; Allen Hazen; Julian Hinds; R. E. Horton; Thaddeus Merriman; Lynn Perry; C. E. Ramser; F. S. Scobey; Charles W. Sherman.

Flow in Natural Channels.—C. I. Corp, A. S. M. E.; N. R. Gibson; R. E. Horton; I. E. Houk; C. E. Ramser; F. C. Shenehon.

Flow Over Weirs.—C. M. Allen; H. K. Barrows; F. W. Greve, Purdue Univ., Lafayette, Ind.; H. P. Hammond; C. W. Harris, Univ. of Washington, Seattle, Wash.; L. F. Harza, Allen Hazen; Clemens Herschel; Julian Hinds; R. E. Horton; J. O. Jones; W. H. Kenerson, A. S. M. E.; Karl R. Kennison; Ford Kurtz; R. L. Parshall; F. A. Nagler; E. W. Schoder.

Flow Through Long Concrete Conduits.—C. H. Eiffert; John Ericson.

Flow Through Contractions in Open Channels.—L. F. Harza; Allen Hazen; E. W. Lane.

Flow Through Culverts.—F. A. Nagler; H. A. Thomas, Carnegie Inst. of Technology, Pittsburgh, Pa.; D. L. Yarnell.

Flow Through Head-Gates.—H. K. Barrows; Julian Hinds; R. E. Horton; R. L. Parshall.

Flow Through Orifices.—F. W. Greve, Purdue Univ., Lafayette, Ind.; Allen Hazen; Julian Hinds; J. O. Jones; H. H. Jordan; E. W. Lane; R. T. Livingston, A. S. M. E.; W. S. Pardoe; R. L. Parshall; Fred B. Seely, Urbana, Ill.

Flow Through Pipes.—H. K. Barrows; C. I. Corp, A. S. M. E.; W. F. Durand, A. S. M. E.; M. L. Enger; John R. Freeman; N. R. Gibson; F. E. Giesecke; W. B. Gregory; F. W. Greve, Purdue Univ., Lafayette, Ind.; Allen Hazen; Karl R. Kennison; Thaddeus Merriman; W. S. Pardoe; Lynn Perry;

D. W. Proebstel, Portland Elec. Power Co., Portland, Ore.; C. E. Ramser; E. W. Schoder; F. S. Scobey; D. L. Yarnell.

Flow Through Pipe Fittings.—H. E. Babbitt; C. I. Corp, A. S. M. E.; E. A. Dow; M. L. Enger; John R. Freeman; F. E. Giesecke; F. W. Greve, Purdue Univ., Lafayette, Ind.; Allen Hazen; Lynn Perry; E. W. Schoder.

Hydraulic Jump.—John C. Beebe; Karl R. Kennison; F. A. Nagler; R. L. Parshall; R. M. Riegel; S. M. Woodward.

Hydraulic Ram.—L. F. Harza.

Loss of Head at Bridges.—F. A. Nagler.

Mixing of Streams Moving at Different Velocities.—William W. Tefft.

Non-Uniform and Unsteady Flow in Open Channels.—John R. Freeman; R. E. Horton; R. D. Johnson, A. S. M. E.; L. K. Sherman; H. A. Thomas, Carnegie Inst. of Technology, Pittsburgh, Pa.; S. M. Woodward.

Percolation Through and Under Earth Dams.—A. Lincoln Fellows, Denver, Colo.

Pitot Tubes.—C. M. Allen; W. S. Pardoe; D. W. Proebstel, Portland Elec. Power Co., Portland, Ore.; H. A. Thomas, Carnegie Inst. of Technology, Pittsburgh, Pa.

Pulsations in Piezometer Tubes.—F. A. Nagler; D. W. Proebstel, Portland Elec. Power Co., Portland, Ore.

Salt Velocity Method of Water Measurement.—C. M. Allen; H. K. Barrows.

Scouring Velocities.—C. A. Bock; John R. Freeman; Allen Hazen; Barton M. Jones, Pueblo Conservancy District, Pueblo, Colo.

Surge Tanks.—R. D. Johnson, A. S. M. E.; W. F. Durand, A. S. M. E.

Upward Pressure Under Dams.—E. L. Chandler; B. T. Colman; Julian Hinds; E. W. Lane.

Venturi Flume.—R. L. Parshall.

Venturi Meters.—C. M. Allen; Allen Hazen; W. H. Kenerson, A. S. M. E.; Clemens Herschel; W. S. Pardoe.

Water Turbines.—R. E. Horton; L. F. Moody, A. S. M. E.; H. B. Taylor, A. S. M. E.

Engineering Societies Library

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Book Notices*

(January 1 to January 31, 1925)

A Hundred Years of Portland Cement, 1824-1924. By A. C. Davis. Lond., Concrete Publications, Ltd., 1924. 282 pp., illus., diagrams, tab., 10 x 7 in., cloth. $5.00.

This history of the evolution of cement since Smeaton's experiments in 1756, notes the early investigators and describes their experiments, the initial industry, and the methods of manufacture at different periods.

Design of Railway Location. By Clement C. Williams. Second Edition. N. Y., John Wiley & Sons, 1924. 517 pp., illus., diagrams, maps, tab., 9 x 6 in., cloth. $4.00.

This is intended as a textbook, and, therefore, develops underlying principles, including railroad economics, rather than current practice. Although it has in view chiefly the extensive revision and re-location of railroads now in process in the United States, attention is also given to new location.

Introduction to the Practice of Civil Engineering. By E. E. Mann. Lond., Macmillan & Co., 1924. 296 pp., illus., diagrams, 8 x 5 in., cloth. $2.50. (Gift of Macmillan Co., N. Y.)

This volume provides a skeleton framework of knowledge, covering engineering commonplaces for the guidance of the young engineer. It treats of estimating, quantities, the execution of works, methods of construction in various materials, and of the general construction of many classes of works.

Statics: Including Hydrostatics and the Elements of the Theory of Elasticity. By Horace Lamb. Second Edition. Cambridge, England, University Press, 1924. 357 pp., diagrams, 9 x 6 in., cloth. $5.75. (Gift of Macmillan Co., N. Y.)

This textbook is for students with some knowledge of elementary mechanics and ability to apply the methods of the calculus. Prominence is given to graphical statics and elasticity.

Technical Mechanics, Statics, Kinematics, Kinetics. By Edward R. Maurer and Raymond J. Roark. Fifth Edition. N. Y., John Wiley & Sons, 1925. 364 pp., diagrams, tab., 9 x 6 in., cloth. $3.50.

This is a text-book of theoretical mechanics for students of engineering, rewritten, with improvements in the presentation, changes in subject-matter and arrangement, and many new problems.

The Columbia Unveiled. By M. J. Lorraine, M. Am. Soc. C. E., Los Angeles, Times-Mirror Press, 1924. 446 pp. illus., map, port., 8 x 5 in., cloth. $3.50. (Gift of Author.)

In June, 1921, the author built a rowboat at the source of the Columbia River and began a successful solitary journey to its mouth, about 1 200 miles distant. His narrative of the trip is a plain, simple account, accompanied by brief observations on the topography and geology of the country. The story is entertaining.

* The statements made in these notices are taken from the books themselves, and this Society is not responsible for them. Unless otherwise specified, the books in this list have been donated by publishers.

Current Civil Engineering Literature

Key to Abbreviated References to Publications Indexed*

Abbreviated References.	Publication.	Place.
Am. C. Inst.	*American Concrete Institute, Proceedings* (Y.)	Detroit
A. I. E. E.	*American Institute of Electrical Engineers Journal* (M.)	New York
A. R. E. A.	*American Railway Engineering Association, Proceedings* (Y.)	Chicago
A. S. T. M.	*American Society for Testing Materials, Proceedings* (Y.)	Philadelphia
Am. Soc. C. E.	*American Society of Civil Engineers, Proceedings* (M.)	New York
Am. Soc. Mun. Impvts.	*American Society for Municipal Improvements, Proceedings* (Y.)	New York
Am. W. W. Assoc.	*American Water Works Association, Journal* (Bi-M.)	Baltimore
Am. Wood Prs. Assoc.	*American Wood Preservers Association, Proceedings* (Y.)	Chicago
Ann. P. et C.	*Annales des Ponts et Chaussées* (Bi-M.)	Paris
Ann. T. P. Belg.	*Annales des Travaux Publics de Belgique* (Bi-M.)	Brussels
Assoc. Ing. Gand.	*Annales de l'Association des Ingénieurs sortis des Ecoles Spéciales de Gand* (Q.)	Ghent
Bost. Soc. C. E.	*Boston Society of Civil Engineers, Journal* (M.)	Boston
Can. Engr.	*Canadian Engineer* (W.)	Toronto
Cem. Eng.	*Cement and Engineering News* (M.)	Chicago
Cornell C. E.	*Cornell Civil Engineer* (M.)	Ithaca
Dock & Harbour	*Dock and Harbour Authority* (M.)	London
Eng.	*Engineering* (W.)	London
Eng. & Contr.	*Engineering and Contracting* (W.)	Chicago
Eng. Inst. Can.	*Engineering Institute of Canada, Journal* (M.)	Montreal
Eng. N. R.	*Engineering News-Record* (W.)	New York
Engrs. Soc. Pa.	*Engineers' Society of Pennsylvania, Journal* (M.)	Harrisburg
Engrs. Soc. W. Pa.	*Engineers' Society of Western Pennsylvania, Journal* (M.)	Pittsburgh
Engr.	*Engineer* (W.)	London
Engrs. & Eng.	*Engineers and Engineering, Engineers' Club of Philadelphia* (M.)	Philadelphia
Gen. Civ.	*Le Génie Civil* (W.)	Paris
Gesund. Ing.	*Gesundheits Ingenieur* (W.)	Munich
Inst. C. E.	*Institution of Civil Engineers Minutes of Proceedings* (Q.)	London
Inst. Mun. & Co. Engrs.	*Institution of Municipal and County Engineers, Journal* (W.)	London
Int. Ry. Cong. Assoc.	*International Railway Congress Association, Bulletin* (M.)	Brussels
Land. Arch.	*Landscape Architecture* (M.)	Harrisburg
Mech. Eng.	*Mechanical Engineering* (M.) *Journal of the American Society of Mechanical Engineers*	New York
Mil. Engr.	*Military Engineer* (M.)	Washington
Min. & Metal.	*Mining and Metallurgy* (M.) *American Institute of Mining Engineers*	New York
Mun. & Co. Eng.	*Municipal and County Engineering* (M.)	Indianapolis
N. E. W. W. Assoc.	*New England Water Works Association, Journal* (M.)	Boston
N. Y. R. R. Club	*New York Railroad Club, Proceedings* (M.)	Brooklyn
Oest. Ing. Arch. Ver.	*Oesterreichischer Ingenieur und Architekten Verein, Zeitschrift* (F.)	Vienna
Power	*Power* (W.)	New York
Rev. Gen.	*Revenue Générale des Chemins de Fer* (M.)	Paris
Ry. Age	*Railway Age* (W.)	New York
Ry. Eng. & Main.	*Railway Engineering and Maintenance* (M.)	Chicago
Ry. Rev.	*Railway Review* (W.)	Chicago
Schw. Bauz.	*Schweizerische Bauzeitung* (W.)	Zurich
Sci. Am.	*Scientific American* (M.)	New York
Soc. Ing. Civ. Fr.	*Société des Ingénieurs Civils de France, Mémoires et Comptes Rendus* (Q.)	Paris
Ver. deu. Ing.	*Verein deutscher Ingenieure, Zeitschrift* (W.)	Berlin
West. Ry. Club	*Western Railway Club, Proceedings* (M.)	Chicago
West. Soc. Engrs.	*Western Society of Engineers, Journal* (M.)	Chicago
Zeit. Bau.	*Zeitschrift fur Bauwesen* (Q.)	Berlin
Z. d. Bauver.	*Zentralblatt der Bauverwaltung* (W.)	Berlin

* Y = Yearly; Q = Quarterly; M = Monthly; F = Fortnightly; W = Weekly.

A. Applied Sciences

a. Processes of Calculation

2. Graphical and Nomographical Processes

Piliers, Murs Immergés Barrages à Sections Horizontales Egalement Comprimées. Reponse à une Critique.* (Piers, Immersed Walls, Dams, with Equally Compressed Horizontal Sections.) Reply to Critic. J. Duvigneaud. Ann. T. P. Belg. Dec., '24.

B. Applied Mechanics

a. Mechanics of Solids

2. Elastic Solids

Poutre Droite Chargée de bout dans un Milieo Elastique.* (Straight Beam Loaded on the End in an Elastic Medium.) Pigeaud. Ann. P. et C. Sept., '24.

5. Homogeneous Inelastic Solids

Abaque Général pour la Flexion des Pièces en Béton Armé.* (General Table for the Flexure of Reinforced Concrete Pieces.) J. Rimbault. Ann. T. P. Belg. Dec., '24.

b. Hydraulics

3. Industrial Hydraulics

Ice Formations in the Main Sierra Canal.* George E. Loughland. Mil. Engr. Nov.–Dec., '24.

St. Margaret's Bay Hydro Development.* Can. Engr. Dec. 30, '24.

Muscle Shoals One of the World's Largest Water Powers.* Power. Dec. 30, '24.

Water-Power Plant at Forshuvudforsen, Sweden.* Eng. Serial beginning Jan. 2, '25.

Momoyama Hydro-Electric Plant Added to Japanese System.* S. Kinugawa. Eng. N. R. Jan. 22, '25.

Die Propellerturbine.* (The Propeller Turbine.) Robert Dubs. Ver. deu. Ing. Nov. 29, '24.

Die Entwicklung der Wasserkraftmaschinen im Spiegelbild ihres Reklamwesens.* (Development of Water Power Machinery as Reflected in Their Advertisements.) Hans. Baudisch. Oest. Ing. Arch. Ver. Dec. 12, '24.

Die Illsee-Turtmann-Kraftwerke.* (The Illsee-Turtman Power Plant.) J. Büchi. Schw. Bauz. Dec. 13, '24.

Mitteilungen über Zivilingenieurbauten an der Weltkraftkonferenz zu London. (Communications on Civil Engineering Works at the World Power Conference in London.) H. E. Grüner. Schw. Bauz. Serial beginning Dec. 20, '24.

Die Bauausführung des Walchenseewerkes.* (Construction on the Walchen Lake Project.) Mattern. Z. d. Bauver. Dec. 20, '24.

Die Wasserkraft-Speicheranlagen Tübingen und Reutlingen.* (Water Power Storage Plants at Tübingen and Reutlingen.) A. Mass. Ver. deu. Ing. Dec. 27, '24.

C. Materials of Construction and General Processes

a. Lime, Cement, Mortar, Concrete, Brick, Bitumen, etc.

Moisture in Sands Affects Proportions in Concrete Mixtures.* R. R. Litehiser. Ry. Eng. & Main. Jan., '25.

Portland Cement. J. M. Oxley. Eng. Inst. Can. Jan., '25.

Erfahrungen mit Zementmortel im Hochbau. (Experiences with Cement Mortar in High Buildings.) Hasak. Z. d. Bauver. Nov. 26, '24.

Einfache Prüfung von Zement für Verbraucher. (Simplified Testing of Cement for the User.) Ernst Natho. Z. d. Bauver. Nov. 26, '24.

Laboratoriumsuntersuchungen und praktische Erfahrungen über hygienische Eigenschaften soganannter Ersatzbauweisen. (Laboratory Investigations and Practical Experiences on the Hygienic Properties of the So-Called Substitute Building Methods.) A. Korff-Petersen. Gesund. Ing. Dec. 20, '24.

Gussbeton in Deutschland und in Nordamerika.* (Cast Concrete in Germany and in North America.) F. W. Schmidt. Z. d. Bauver. Dec. 20, '24.

b. Metals

L'Alférium, Alliage Léger d'Aluminium pour les Constructions Aéronautique et Automobile. (Alferium, a Light Aluminum Alloy for Aeronautical and Automobile Construction.) Gen. Civ. Dec. 27, '24.

c. Preservation and Use of Materials

The Preservation of Marine Structures.* Wm. G. Atwood. Mil. Engr. Nov.–Dec. '24.

Delivering Material Direct to Bridge Reduces Renewal Cost.* Ry. Eng. & Main. Jan., '25.

Creosoting of Materials as Relating to Constructive Engineering.* Richard V. Look. Eng. Inst. Can. Jan., '25.

Verbesserung der Holztränkung durch Anstechverfahren.* (Improving Wood Impregnation by Piercing Method.) Robert Nowotny. Ver. deu. Ing. Dec. 6, '24.

g. Execution of Works. Specifications

5. Of Reinforced Concrete

Belt Conveyor Handles Concrete for Large Aqueduct.* Eng. N. R. Jan. 22, '25.

Les Nouvelles Tribunes du Champ de Courses du Bois de Vincennes, Pres de Paris.* (The New Stands at the Bois de Vincennes Race Track near Paris.) Ch. Dantin. Gen. Civ. Dec. 20, '24.

h. Foundations, Bridge Piers and Abutments

Novel Construction of Concrete Foundations for Structures. W. G. Kirchoffer. Mun. & Co. Eng. Dec., '24.
Heavy Foundations on Sand Rock, Nebraska Capitol.* Ralph H. Chambers. Eng. N. R. Jan. 15, '25.
New Method for Supporting Building Columns.* George E. Goodall. Eng. N. R. Jan. 22, '25.

j. Piles and Pile-Driving

Developments in Connection with Concrete Piling.* J. W. Ludlow. (Paper read before Am. Assoc. of Port Auth.) Dock & Harbour Jan., '25.

l. Construction Machinery and Tools—Drainage

Les Effets del'Inertie dans les Appareils de Levage et leurs Conséquences.* (Effects of Inertia in Hoisting Apparatus and Their Consequences.) Armand Duclos. Gen. Civ. Dec. 27, '24.

D. Highways

c. Construction

Efficiency the Safety Factor in Roads.* D. T. Lloyd-Jones. Inst. Mun. & Co. Engrs. Dec., '24.
Resurfacing Old Roads and Streets with Kyrock.* Mun. & Co. Eng. Dec., '24.
The Present Day Design of Sheet Asphalt Mixtures. Gene Abson. Mun. & Co. Eng. Dec., '24.
Black Base Construction Increases in Middle West.* Hugh W. Skidmore. Mun. & Co. Eng. Dec., '24.
Utility of Flexible Base Pavements. E. C Schmidt. Can. Engr. Dec. 23, '24.
Improvements in Asphalt Pavements.* Prevost Hubbard. (Paper read before Asphalt Paving Conference.) Can. Engr. Dec. 30, '24.
Timber Road of Portable Sections Laid on California Desert.* Eng. N. R. Jan. 1, '25.
Constructing Concrete Roads by Vibration.* Eng. N. R. Jan. 1, '25.
Construction of Sand Asphalt Pavements. H. C. Weathers. (Paper read before Third Annual Paving Conference.) Can. Engr. Jan. 6, '25; Eng. & Contr. Jan. 7, '25.
Worn Macadam and Gravel as Foundations. Charles E. Murphy. Eng. & Contr. Jan. 7, '25.
Concrete Pavements of Contra Costa County, California.* Ralph R. Arnold. Eng. & Contr. Jan. 7, '25.
Highway Reconstruction with State Owned Outfit.* H. J. Friedman. Eng. & Contr. Jan. 7, '25.
Black Base Paving at Clinton, Ia. Benton R. Anderson. (Paper read before Third Asphalt Paving Conference.) Eng. & Contr. Jan. 7, '25.
Troisiéme Note Relative à l'Emploi du Silicate de Soude comme Liant. (Third Note on the Use of Sodium Silicate as a Binder.) Guelle. Ann. P. et C. Sept., '24.
Emploi du Chlorure de Calcium dans la Construction des Routes en Béton et dans les Maçonneries. (Use of Calcium Chloride in the Construction of Concrete Roads and in Masonry.) Ann. T. P. Belg. Dec., '24.

d. Maintenance

State Highway Officials Report on Maintenance. Mun. & Co. Eng. Dec., '24.
Patching Concrete Roads with Concrete. W. R. Eccles. (From *New Mexico Highway Journal.*) Jan. 7, '25.
Comment Eviter la Fissuration des Routes Bétonnés. (How to Avoid Cracking in Concreted Roads.) Ann. T. P. Belg. Dec., '24.

e. Street Cleaning, Dust Prevention, Snow Removal

Highway Snow Removal Practice Summarized.* Eng. N. R. Jan. 1, '25.

h. Vehicles. Automobiles. Traffic

Highway Research Board Report on Highway Traffic Analysis. Mun. & Co. Eng. Dec., '24.
The Influence of Road Conditions on the Development of the Modern Motor Vehicle.* H. G. Burford. (Paper read before World Power Conference.) Eng. Dec. 26, '24.
Hazards and Safeguards of Highway Structure.* (Report of Comm. read before Nat'l Conference on Street Paving.) Eng. N. R. Jan. 1, '25.
Motor Truck Impact Tests. A. C. Hogentogler. (From *Public Roads.*) Eng. & Contr. Jan. 7, '25.
Technische Wirkungen gesteigerten Kraftwagenverkehrs. (Technical Effects of Increased Automotive Traffic. K. A. Müller. Ver. deu. Ing. Dec. 13, '24.
Fortschritte im Kraftwagenbau.* (Advances in Automotive Construction.) A. Heller. Ver. deu Ing. Dec. 13, '24.

x. Miscellaneous

Research Work to Improve Asphalt Paving Mixtures.* Prevost Hubbard. (Paper read before Third Asphalt Paving Conference, Louisville.) Mun. & Co. Eng. Dec., '24.
Proprietary Asphalt Pavements Covered by Trade Names and Patents. Charles A. Mullen. Eng. Inst. Can. Jan., '25.

E. Bridges, Viaducts, and Arches

b. Iron or Steel Bridges and Viaducts

New M. C. R. Bridge Over Niagara River.* Can. Engr. Jan. 6, '25.
Restoring a Steel Bridge After Landslide Movement.* E. K. Triol. Eng. N. R. Jan. 15, '25.

Die Unterfangung des mittlern Pfeilers der Rhein-Brücke für die Basler Verbindungsbahn.* (Underpinning the Central Piers of the Rhine Bridge of the Basel Connecting Line. F. Waity. Schw. Bauz. Dec. 6, '24.

Die Umrechnung von eisernen Eisenbahnbrücken nach den Vorschriften der Deutschen Reichsbahn.* (Calculation of Iron Railroad Bridges According to the German Railroad Specifications. Edgar Schmidt. Z. d. Bauver. Dec. 20, '24.

F. Inland Waters

c. Regulation of Waterways, Volumes of Discharge, Freshets, Floods, Soundings

Zur Berechnung der Dauer der Wasserstände.* (On the Calculation of the Duration of Water Levels.) Alexander Parenski. Oest. Ing. Arch. Ver. Dec. 26, '24.

d. Diverting Dams

Welland Canal Construction Progress.* Can. Engr. Dec. 23, '24.

Porte d'Ecluse en Béton Armé sur le Canal du Rhone au Rhine. (Reinforced Concrete Lock Gates on the Canal from the Rhone to the Rhine.) Ann. T. P. Belg. Dec., '24.

g. Consolidation of Banks, Leakage, etc.

Cape Fear River Channel and Bar.* Oscar O. Kuentz. Mil. Engr. Jan.–Feb. '25.

j. River Equipment, Lake Ports

Le Port Maritime et Fluvial de Rotterdam, Hollande.* (Seaport and River Port at Rotterdam, Holland.) Alfred Bijls. Gen. Civ. Dec. 6, '24.

G. Maritime Works

a. Behaviour of Movements of the Ocean. Winds. Waves. Tides. Currents

Measurement of Tides at New York.* John M. Buckley. Mil. Engr. Nov.–Dec., '24.

b. Management and Protection of the Ocean

Problems Involved in Coast Erosion.* R. S. Patton. Mil. Engr. Nov.–Dec., '24.

c. Vessels and Maritime Navigation, etc.

Tests of Marine Boilers.* (From *Bulletin 214*, U. S. Bureau of Mines.) Engrs. & Eng. Dec., '24.

d. Roads and Outer Harbors. Dikes and Jetties. Breakwaters

Abschluss und Trockenlegung der Zuidersee.* (Shutting-off and Draining the Zuider Zee.) R. Schmidt. Z. d. Bauver. Serial beginning Dec. 3, '24.

g. Dredges and Dredging. Force Pumps. Refloating and Removing Wrecks. Ice-Breakers

Dredging and Dredging Plant.* O. C. A. Van Lidth de Jeude. Doc. & Harbour Jan., '25.

i. Harbors (General Articles)

Gothenberg: The Chief Port of Sweden.* Knut E. Petterson. Dock & Harbour Jan., '25.

Les Travaux d'Extension du Port du Havre.* (The Work of Enlarging the Port at Havre.) Maurice Michel-Schmidt. Soc. Ing. Civ. Fr. July '24.

Der Neubau des Königsberger Handels- und Industriehafens.* (Rebuilding the Königsberg Commercial and Industrial Harbor.) Kutschke. Ver. deu. Ing. Dec. 6, '24.

j. Dockyard Machinery and Shipyards. Dry Docks

Gantry Wagon Tips for Coaling Depots at River and Sea Ports.* E. Krahnen. Dock & Harbour Jan., '25.

H. Railroads. Street and Interurban Railways. Automobiles. Aeronautics

a. Railroads

1. General Articles

Die Schäden an den Eisenbahnens Japans durch das Erdbeben vom 1 September 1923. (Damages to the Japanese Railroads by the Earthquake of September 1, 1923.) Z. d. Bauver. Dec. 20, '24.

3. Roadbed. Construction Work

Southern Pacific Builds Rock Crushing Plants with Large Output.* Ry. Eng. & Main. Jan., '25.

4. Track

Les Causes de l'Usure des Rails de Chemins de Fer.* (Causes of Wear of Railway Rails.) Gen. Civ. Dec. 6, '24.

5. Signals and Safety Apparatus

The Baltimore & Ohio Railroad Company Color Position Light Signals.* F. P. Patenall. Int. Ry. Cong. Dec., '24.

Great Northern Installs Train Control.* Ry. Age Jan. 10, '25.

Railway Signaling Methods for Public Roads.* Lewis E. Moore. Eng. N. R. Jan. 22, '25.

6. Rolling Stock (Locomotives, Cars) Fuel

Santa Fe Type Locomotives for Baltimore & Ohio.* Ry. Rev. Jan. 10, '25.

New Lehigh Valley Milk Cars.* Ry. Age Jan. 17, '25.

N. Y. C. Electric Freight Locomotive.* Ry. Age Jan. 17, '25.
Nouvelle Serrure, Système "Birlé", pour la Fermeture des Portières de Voitures des Chemins de Fer.* ("Birlé" Type of New Lock for Fastening the Doors of Railroad Cars.) M. Latrasse. Rev. Gen. Dec., '24.
Vereinheirlichungsbestrebungen im Lokomotivbau.* (Standardization Efforts in Locomotive Construction.) J. Rihosek. Oest. Ing. Arch. Ver. Dec. 12, '24.

7. Use of Electricity

The Electrification of the Swiss Federal Railways.* Int. Ry. Cong. Dec., '24.

8. Stations, Engine Houses, Shops, Terminals

The New Engine Shed at Schaerbeek-Formation.* J. Van Rijn and A. Chantrell. Int. Ry. Cong. Assoc. Dec., '24.
Upkeep of Road Maintenance Equipment.* C. S. Hill. Eng. N. R. Jan. 1, '25.
Southern Railway Opens New Shops at Birmingham.* Ry. Rev. Jan. 3, '25.
Railroad Provides Facilities for Football Crowds.* O. T. Dunn. Ry. Age Jan. 10, '25.
Wabash Ry. Completes New Store and Oil House.* Ry. Rev. Jan. 10, '25.

10. Accidents

Note sur la Securité de la Circulation dans les Chemins de fer depuis la Guerre. (Note on the Safety of Operation of Railroads Since the War.) F. Maison. Soc. Ing. Civ. Fr. Sept., '24.

f. Aeronautics

1. General Articles

La IXe Exposition Internationale de l'Aéronautique, Paris, Decembre 5-21, 1924.* (The Ninth International Aeronautic Exposition.) André Lesage. Gen. Civ. Serial beginning Dec. 13, '24.

2. Dirigible Balloons

Can Huge Dirigibles Supplant Our Ocean Liners?* Alexander Klemin. Sci. Am. Jan., '25.

I. Municipal Water-Works. Agricultural Engineering. Irrigation

a. General Articles

Water Supply and Sewage Disposal in the Ruhr Valley.* Karl Imhoff. Eng. N. R. Jan. 15, '25.

e. Distribution of Water

Irrigation and Community Development.* W. H. Snelson. Can. Engr. Jan. 13, '25.

f. Drainage of Land

Some Notes from the Drainage Congress Convention. Eng. N. R. Jan. 22, '25.

J. Sewerage. Sewage and Refuse Disposal

a. Sewers and Drains

Rejuvenating Old Brick Sewers Rapidly and Thoroughly.* Frank W. Skinner. Mun. & Co. Eng. Dec., '24.

b. Sewage Disposal. Purification

Water Supply and Sewage Disposal in the Ruhr Valley.* Karl Imhoff. Eng. N. R. Jan. 15, '25.

L. Electricity

b. Distribution and Transmission of Electricity

1. Power Plants

Riverside Station of the United Light and Power Co. Power Jan. 13, '25.
L'Organization et les Travaux de l'Hydro-Electric Power Commission of Ontario. (The Organization and Works of the Hydro-Electric Power Commission of Ontario.) Gen. Civ. Dec. 20, '24.
La Nouvelle Centrale Electric à Moteurs Diesel de la Concession Français de Shanghai.* (The New Electric Central Station with Diesel Engines for the French Concession in Shanghai.) Gen. Civ. Dec. 27, '24.

2. Long-Distance Transmission of Energy

High Voltage Phenomena.* G. Faccioli. West. Soc. Engrs. Dec., '24.
Artificial Representation of Power Systems.* H. H. Spencer and H. L. Hazen. A. I. E. E. Jan., '25.

M. Architecture

b. Business and Commercial Buildings

The Tribune Tower. Holmes Onderdunk. West. Soc. Engrs. Dec., '24.
Mechanical Equipment of the Tribune Tower. J. A. Sutherland. West. Soc. Engrs., Dec., '24.
The Tribune Tower.* H. J. Burt. West. Soc. Engrs. Dec, '24.
Die neue Automobil-Ausstellungshalle des Reichsverbandes der Automobilindustrie.* (The New Automobile Exhibition Hall of the National Association of the Automobile Industry.) J. Krämer and Hans Schmuckler. Ver. deu. Ing. Serial beginning Dec. 13, '24.

Das neue Dienstgebäude der Oberpostdirektion in München.* (The New Office Building of the General Post Office in Munich.) A. Gut. Z. d. Bauver. Dec. 20, '24.

c. Residences, Hotels

Die Wohnkolonien der Baugenossenschaft des eidgen. Personals in Zürich.* (Community Dwellings of the Building Association Formed by Government Employees in Zurich.) Schw. Bauz. Serial beginning Dec. 6, '24.

f. Factories and Mill Buildings

Contractor Maintains Service and Repair Plant.* Eng. N. R. Jan. 15, '25.

O. Administration. Legislation. Economics. Statistics

d. Administrative and Financial Management of Means of Communications

2. Routes and Roads

Building a State Highway System by Bond Issue. C. P. Fortney. (Paper read before Third Asphalt Paving Conference, Louisville.) Mun. & Co. Eng. Dec., '24.

Die Deutsche Reichsbahn-Gesellschaft. (The German Railroad Company.) Z. d. Bauver. Dec. 10, '24.

Q. Surveying and Geodesy

Terrestrial Magnetism of the U. S.* N. H. Heck. Mil. Engr. Nov.–Dec., '24.

Mapping with the Single-lens Camera.* Robert C. Hunter. Mil. Engr. Nov.–Dec., '24.

Modern Methods of Chart Engraving.* John H. Larrabee. Mil. Engr. Jan.–Feb., '25.

Accurate Maps and the City Plan.* Hugh C. Mitchell. Mil. Engr. Jan.–Feb., '25.

R. Landscape Engineering

A Practicable Photograph Filing System for Landscape Architects.* Malcolm H. Dill. Land. Arch. Jan., '25.

Planning the Modern Park Cemetery.* Howard K. Menhinick. Land. Arch. Jan., '25.

S. City Planning

Die Gartenstadtbewegungen in Deutschland.* (The Garden City Movement in Germany.) Adolf Otto. Gesund. Ing. Dec. 20, '24.

Employment Service

The Engineering Societies Employment Service is under the joint management of the National Societies of Civil, Mining, Mechanical, and Electrical Engineers as a co-operative Bureau available only to their membership, and maintained by the contributions from the Societies and their individual members who are directly benefited.

Men Available.—Under this heading, brief announcements will be published without charge. These announcements will not be repeated, except on request received after an interval of one month. Names and records will remain in the active files of the Bureau for a period of three months and are renewable on request. Notice for *Proceedings* should be addressed to employment Service, 33 West 39th Street, New York, N. Y., and should be received prior to the first of the month.

Opportunities.—A Bulletin of engineering positions available is published weekly and is available to members of the Societies concerned at a subscription rate of $3 per quarter, or $10 per annum, payable in advance. Positions which are not filled promptly as a result of publication in the Bulletin, may be announced herein.

Voluntary Contributions.—Members obtaining positions through the medium of this Service are invited to co-operate with the Societies in the financing of the work by nominal contributions made within thirty days after placement, on the basis of $10 for all positions paying a salary of $2 000 or less per annum; $10 plus 1% of all amounts in excess of $2 000 per annum; temporary positions (of one month or less), 3% of total salary received. The income contributed by the members, together with the finances appropriated by the four Societies named, will be sufficient, it is hoped, not only to maintain but to increase and extend the service.

Replies to Announcements.—Replies to announcements published herein, or in the Bulletin, should be addressed to the key number indicated in each case, with a two-cent stamp attached for re-forwarding, and forwarded to the Employment Service at the address given. Replies received by the Bureau after the positions to which they refer have been filled, will not be forwarded.

POSITIONS AVAILABLE

STRUCTURAL DESIGNER, on bascule and other movable bridges. Engineer who has had experience in structural steel design where live loads and heavy vibrations must be taken into account. Salary $275 a month. Location, Middle West. R–5358.

REAL BUILDING ESTIMATOR, big enough to take charge of estimating department. Must be able to estimate from architects' plans, make an estimate, alternate design in steel, concrete, or other material without engineering help. Must have served in a similar capacity for other large general contractors. Such a man will have unlimited possibilities for advancement in proportion to the value of services he renders to a firm of contractors having been twenty-five years in business with plenty of capital and an excellent reputation. Apply by letter with full particulars. Firms estimators have been advised of this advertisement. Location, New York. R–5468.

REINFORCED CONCRETE DESIGNERS, two or three years' experience in general building construction. Experience with bar steel company desirable. Salary about $225 a month. Location, New York. R–5522.

STRUCTURAL STEEL DESIGNER AND DRAFTSMAN, 30 to 35, for mercantile and reinforced concrete buildings. Salary $60 a week. Location, East. R–5528.

ENGINEER DRAFTSMAN, with experience in design of structural steel and reinforced concrete for position in the engineering department of a corporation doing all its engineering work. General experience in

industrial maintenance and construction work will also be helpful. Must have good personality and be technical graduate. Location, Western Pennsylvania. R–5556.

MEN AVAILABLE

CIVIL ENGINEER AND CONSTRUCTION SUPERINTENDENT, Assoc. M. Am. Soc. C. E.; Major, Engineer Reserve Corps; age 36; married. Fourteen years' experience hydro-electric, irrigation, drainage, and logging developments. Qualified to handle job from preliminary studies to completion. Available March 1. B–5135.

RESIDENT OR CONSTRUCTION ENGINEER, Assoc. M. Am. Soc. C. E.; age 39; single; American born; Protestant; now available and willing to go anywhere. Technical graduate in course of C. E. Eighteen years' experience on construction of hydro-electric plants, reinforced concrete caissons, river and harbor work, and factory buildings; also, steam electric plants with intake tunnels. B–6942.

CIVIL ENGINEER, M. Am. Soc. C. E. Twenty years' experience on railroad location, construction and maintenance; bridge construction, steel and reinforced concrete, foundations, coffer-dams, highways, and general surveys. Chief Engineer in charge of large construction works, by contract and by administration, in Latin-American countries. Speaks Spanish. Least salary, $5 000. B–7108.

TEACHER, M. Am. Soc. C. E. Nineteen years' experience in field and office as a civil and hydraulic engineer. At present, principal of small high school and teaches mathematics and physics. Desires position on teaching staff of college or university after June 1, 1925. B–7634.

MECHANICAL AND CIVIL ENGINEER, Assoc. M. Am. Soc. C. E.; age 38; married. Graduate in Mechanical, Electrical, and Civil Engineering, broad experience since 1911. Machinery designing and manufacturing, research and consulting engineering; assistant professor in college. Some experience in structural design. Russian. Available at once. Location, New York City. B–8303.

CIVIL ENGINEER, Assoc. M. Am. Soc. C. E. Fourteen years' continuous engineering experience, covering railroad maintenance, location, and construction in its various branches, as building of new lines, grade reduction on an extensive scale, track elevation, and yard construction. Best of credentials. B–9037.

GRADUATE CIVIL ENGINEER, Assoc. M. Am. Soc. C. E.; married. Thirteen years' experience in highways, highway bridges, and structural work; design, construction, office organization, and administration, as detailer, designer, chief draftsman, assistant engineer, and State bridge engineer. Desires position of responsibility with State Highway Department, corporation, or contractor. Available now. B–9319.

HYDRAULIC AND SANITARY ENGINEER, Assoc. M. Am. Soc. C. E. Six years' experience in hydraulic investigations, waterworks, and sewerage investigation, design, and construction. Has been in charge of design and construction of concrete and timber hydraulic structures. Desires responsible position in field or office. B–9368.

CIVIL ENGINEER, Assoc. M. Am. Soc. C. E.; married; age 35. Field or office man with executive ability, desires connection with contractor or engineer located in the South or South Central States, specializing in concrete highway, bridge, and building work. Competent to handle any phase of the work; design, estimating or construction. Now employed; can leave on reasonable notice. B–9389.

CIVIL ENGINEER, Assoc. M. Am. Soc. C. E. Fifteen years general engineering experience in United States and South America. Work has included logging, highways, industrial building, irrigation, and railroad work. Wants connection with firm doing work in South America or Western United States. Fair knowledge of Spanish. B–9394.

CONSTRUCTION ENGINEER with C. E. degree and thirteen years' experience on railroad work and large industrial operations, desires position of resident engineer with firm of architects or consulting engineers. B–9415.

Membership

(From January 7, to February 3, 1925)

Additions

		Date of Membership.
ALDERSON, George France. Res. Engr. and Constr. Supt., William M. Francis, West Chester (Res., Kennett Square), Pa.	Assoc. M.	Jan. 19, 1925
ANDERSEN, Aksel Pauli. Designer, Gustav Lindenthal, Room 738, Penn. R. R. Station, New York (Res., 567 Fifth St., Brooklyn), N. Y.	Assoc. M.	Jan. 19, 1925
ANDREWS, Aden Wright. Office Engr., C. B. & Q. R. R., 444 South 33d St., Lincoln, Nebr.	M.	Dec. 15, 1924
ARNEBERG, Birger. 147 Prospect Pl., Brooklyn, N. Y.	Assoc. M.	Dec. 15, 1924
BACON, Robert Harold. Chf. Structural Engr., City of Los Angeles (Res., 136 South Normandie Ave.), Los Angeles, Calif.	M.	Jan. 19, 1925
BADGLEY, Ben Oliver. Supt. of Eng. and Constr., J. Harrey McCarthy Co., 326 H. W. Hellman Bldg., Los Angeles, Calif.	Assoc. M.	Dec. 15, 1924
BASCOME, Bartow Strang. Care, Am. Constr. & Securities Co., 50 Broad St., New York, N. Y.	Assoc. M.	Jan. 19, 1925
BATTY, Frederic Arthur. Asst. Chf. Engr., Outfall Sewer, 942 South Bronson Ave., Los Angeles, Calif.	Assoc. M.	Dec. 15, 1924
BAUER, Edward Ezra. Asst. Engr., City of Urbana (Res., 709 West Stoughton St.), Urbana, Ill.	Assoc. M.	Jan. 19, 1925
BERG, John. State Engr., Pierre, S. Dak.	Assoc. M. M.	Oct. 7, 1914 Jan. 19, 1925
BERRY, Byron Conrade. Res. Engr., Sewer Dept. (Res., 468 Grace St.), Toronto, Ont., Canada.	Assoc. M.	Dec. 15, 1924
BONE, Lewis Bernard. Dist. Agt., Austin Bridge Co., 143 Katherine Court, San Antonio, Tex.	Assoc. M.	Dec. 15, 1924
BOTTUM, Curtis Edward. Res. Engr., Holland, Ackerman & Holland, Sanford, Mich.	Assoc. M.	Dec. 15, 1924
BROWN, Henry Gassaway, Jr. Eng. Asst., Public Service Production Co., Newark (Res., 32 North Arlington Ave., East Orange), N. J.	Jun.	Jan. 19, 1925
CARROLL, Hugh Joseph. 598 West 191st St., New York, N. Y.	Assoc. M.	Dec. 15, 1924
COCHRAN, John Andrews. 406 South Front St., Wheeling, W. Va.	Jun.	Jan. 19, 1925
COE, Edward Harold. 2d Lieut., Corps of Engrs., U. S. A., Fort Humphreys, Va.	Jun. Assoc. M.	Oct. 11, 1920 Dec. 15, 1924
CONRAD, Charles Sumner. Valuation Engr.; Mgr., Shreveport Office, Mattison & Davey, Room 311, Giddens-Lane Bldg., Shreveport, La.	Assoc. M.	Jan. 19, 1925
COTTEN, Shepard Marrast. Structural Engr., Oakland-Alameda Estuary Tube, Alameda County Project (Res., 5316 Miles Ave.), Oakland Calif.	Assoc. M.	Jan. 19, 1925
COULSON, Ernest Brown. Chf. Engr., The Utah Cent. R. R., 65 I St., Salt Lake City, Utah.	M.	Dec. 15, 1924
COYLE, David Cushman. Designing Engr., Gunvald Aus Co., 244 Madison Ave., New York, N. Y.	M.	Oct. 21, 1924
CROUT, Paul Gwynn. Structural Engr., Herman F. Doeleman, 2307 Barclay St., Baltimore, Md.	Jun.	Jan. 19, 1925
DERBY, Austin Clark. 5303 St. George's Ave., Baltimore, Md.	Jun.	Jan. 19, 1925
DE WITT, Clinton. Asst. Engr., Pacific Gas & Elec. Co., San Francisco (Res., 3148 College Ave., Berkeley), Calif.	Assoc. M.	Dec. 15, 1924
DOLSON, Fred Otis. Vice-Pres. and Asst. Gen. Mgr., Southern Sierras Power Co. (Res., 461 West 7th St.), Riverside, Calif.	M.	Dec. 15, 1924
DOWNIE, Edward James. Chf. Engr., Fagan Iron Works, Coles and 14th St., Jersey City (Res., 101 Park Pl., Irvington), N. J.	Assoc. M.	Dec. 15, 1924
EARLE, Frank Hasbrouck. Vice-Pres., R. B. Cahill & Co., Inc., 299 Central Ave., Newark (Res., 59 South Parkway, East Orange), N. J.	Affiliate	Jan. 19, 1925
EVERETT, Roy Edward. Designer, Commonwealth Power Corporation, Route 9, Jackson, Mich.	Jun.	Jan. 19, 1925
FEAGIN, Lawrence Baker. Draftsman, U. S. Govt., Box 994, East Florence, Ala.	Jun.	Dec. 15, 1924
FEER, Hugo Anthony. 58 Pine St., Maplewood, N. J.	Jun.	Dec. 15, 1924
FERNALD, Frank Osborne. 308 Union Terminal Station Bldg., Dallas, Tex.	Assoc. M.	Aug. 4, 1924

MEMBERSHIP—(*Continued*)

		Date of Membership.
FORD, James Blaine. Chf. Engr., Roane Iron Co., 308 Rockwood Ave., Rockwood, Tenn	Assoc. M.	Dec. 15, 1924
GERHARD, Norman Paul. Civ. Engr. and Surv., Parkway Bldg., Scarsdale, N. Y.	Assoc. M. M.	April 2, 1913 Jan. 19, 1925
GLEASON, Daniel Walters. Designing Engr., Henry L. Doherty & Co., 10 Bridge St., New York (Res., 1303 Dean St., Brooklyn), N. Y.	Assoc. M.	Jan. 19, 1925
GORMAN, Sidney Silvey. Constr. Engr., Standard San. Mfg. Co., 1000 Brannan St. (Res., 778 Faxon Ave.), San Francisco, Calif.	Jun. Assoc. M.	Sept. 12, 1921 Jan. 19, 1925
GRAHAM, Leland Little. (Chapman & Graham, Inc.), 132 Blackstone Ave., Jamestown, N. Y.	M.	Jan. 19, 1925
GWATHMEY, William Watts, Jr. Asst. Engr., B. & O. R. R., 901 Goff Bldg., Clarksburg, W. Va	Assoc. M.	Jan. 19, 1925
GWILLIM, Edward Cecil. City Engr., Box 130, Sheridan, Wyo	Assoc. M.	Jan. 19, 1925
HALE, Hal Henderson. Draftsman and Insp., Dept. of Public Service (Res., 1319 Highland Ave.), Knoxville, Tenn	Jun.	Jan. 19, 1925
HAMILTON, Raymond Tompkins. 436 Englewood Court, Fort Wayne, Ind.	Jun.	Dec. 15, 1924
HAWKINS, Floyd Leroy. Asst. Engr., State Road Comm., Box 704, Martinsburg, W. Va	Assoc. M.	Jan. 19, 1925
HEINS, Frank Conrad. Asst. Paving Engr., City of Laredo, Box 562, Laredo, Tex	Assoc. M.	Dec. 15, 1924
HULSCHER, Harold Thomas. Asst. Engr., C. L. & B. Constr. Co., Box 632, Titusville, Pa	Jun.	Jan. 19, 1925
JIRANEK, Leo August. Asst. Supt., Turner Constr. Co., Princeton Club, New York, N. Y	Jun.	Dec. 15, 1924
JOHNS, James Edmond. 321 South Cedar St., Lansing, Mich	Jun.	Dec. 15, 1924
KERR, Samuel Logan. Asst. Hydr. Engr., I. P. Morris Dept., Wm. Cramp & Sons Ship & Engine Bldg. Co., Richmond and Norris Sts., Philadelphia, Pa	Jun.	Jan. 19, 1925
KIRKPATRICK, Carlos Stevens. Chf. Engr., Gulf Coast Lines, 407 Union Station, Houston, Tex	M.	Dec. 15, 1924
KIST, Herman Jacob. 230 St. Marks Pl., St. George, N. Y	Jun.	Dec. 15, 1924
LAMPRECHT, Joseph. Asst. Engr., Utica Gas & Elec. Co., Utica (Res., 135 Genesee St., New Hartford), N. Y	Assoc. M.	Oct. 21, 1924
LANE, George Samuel. Draftsman, Union Oil Co. of California, 4634 West 17th St., Los Angeles, Calif	Assoc. M.	Dec. 15, 1924
LAUTZ, Martin William. Designing Engr., City Bureau of Water, Filtration Div., 64 Inwood Pl., Buffalo, N. Y	Assoc. M.	Dec. 15, 1924
LOCHER, Harry Orrick. Contr., 1420 Genesee St., Utica, N. Y.	Affiliate M.	April 19, 1920 Jan. 19, 1925
MacDONALD, Albert Frederick. Estimating and Designing Dept., Am. Bridge Co., Frick Bldg., Pittsburgh, Pa	Assoc. M.	Dec. 15, 1924
MANSON, Egbert Farrand. Div. Engr., C. R. I. & P. Ry., Trenton, Mo.	M.	Jan. 19, 1924
MARSHALL, Leslie Stancliffe. With, Charles W. Leavitt, 18 East 41st St., New York (Res., 129 Violet Ave., Floral Park), N. Y.	Assoc. M. M.	May 12, 1919 Jan. 19, 1925
MARSON, Homer Roberts. Asst. Engr., Dept. of Water Supply, 2500 Hurlbut Ave., Detroit, Mich	Assoc. M.	Jan. 19, 1925
MELLIN, Gilbert Francis. Civ. Engr. (Res., 3211 Serra Way), Sacramento, Calif.	Assoc. M.	Dec. 15, 1924
MOHLER, John Donald. Engr., Asphalt Sales Dept., Standard Oil Co. of Indiana, Kansas City (Res., 2740 Duncan St., St. Joseph), Mo.	Assoc. M. M.	Jan. 19, 1920 Dec. 15, 1924
NAKAYAMA, Chusaburo. 41 Komagome Shimmeicho, Hongo-ku, Tokyo, Japan	Assoc. M.	Jan. 19, 1925
PARTRIDGE, John Frederick. Asst. Engr., The California Oregon Power Co., Copco Bldg., Medford, Ore.	Jun. Assoc. M. M.	Feb. 4, 1913 Jan. 19, 1920 Jan. 19, 1925
PHILLIPS, Cushing. Lieut., C. E. C., U. S. N.; Dept. Engr., Northwest and Antibonite, Gonaives, Haiti	Assoc. M.	Dec. 15, 1924
POPE, Lathrop Carleton. Instr. in Civ. Eng., Univ. of Michigan, 609 West Madison St., Ann Arbor, Mich	Assoc. M.	Jan. 19, 1925
REINECKE, Paul Sorg. U. S. Dist. Engr., 540 Federal Bldg., Buffalo, N. Y.	M.	Dec. 15, 1924
RENZ, Carl Fred. Detailer, Am. Bridge Co., (Res., 344 Glenwood Rd.), Ambridge, Pa.	Jun.	Dec. 15, 1924
RICE, Frederick William Peter. Structural Engr., 406 Bankers Reserve Life Bldg. (Res., 1127 South 32d St.), Omaha, Nebr.	Assoc. M. M.	July 11, 1921 Jan. 19, 1925
ROACH, Harry Fay. Archt, 915 Olive St., St. Louis, Mo.	M.	Jan. 19, 1925

MEMBERSHIP—(*Continued*)

		Date of Membership.
ROWE, Donald Hefley. Engr., Lindstrom & Feigenson, 230 Worcester Bldg., Portland, Ore.	Jun.	May 7, 1913
	Assoc. M.	Oct. 14, 1919
	M.	Dec. 15, 1924
SACKS, Samuel Isaiah. Chf. Estimator and Civ. Engr., Wm. Linker Co., 735 Cherry St., (Res., 3219 Fontaine St.), Philadelphia Pa.	Jun.	Nov. 3, 1915
	Assoc. M.	April 16, 1918
	M.	Jan. 19, 1925
SCHWIND, Raymond Charles. Engr., Ferber Const. Co., 16 Johnson Ave., Hackensack (Res., 52 Spruce Ave., Ridgefield Park), N. J.	Assoc. M.	Jan. 19, 1925
SHAFER, George Elmer. Care, Bragman Bluff Lumber Co., Puerto Cabezas, Nicaragua	Jun.	Oct. 21, 1924
SKINNER, Alfred Edwin. Western Mgr., The Pitometer Co., 53 West Jackson Boulevard, Chicago, Ill.	Assoc. M.	Dec. 15, 1924
SLATTERY, Fremont W. Asst. Engr., Imperial Irrig. Dist. (Res., 816 Heber St.), Calexico, Calif.	Assoc. M.	Dec. 15, 1924
SPAYDE, Keith Crawford. Contr. Engr., McClintic-Marshall Co., 50 Church St., New York (Res., 115 Parkside Ave., Brooklyn), N. Y.	Assoc. M.	Dec. 15, 1924
STANDIFORD, Harry Ralph. Asst. Chf. Engr., William F. Kenny Co., 44 East 23d St. (Res., 1454 University Ave.), New York, N. Y.	M.	Dec. 15, 1924
STAUBACH, Arnold Baldwin. Structural Architectural Designer, Lockwood, Greene & Co., 100 East 42d St., New York, N. Y. (Res., 270 Ridgewood Ave., Glen Ridge, N. J.)	Jun.	Jan. 19, 1925
STROMSOE, Douglas Albert. 1643 Locust Ave., Long Beach, Calif.	Jun.	Aug. 4, 1924
STURDY, Nathan Henry. Mgr., Educational Dept., Truscon Steel Co. (Res., 356 Crandall Ave.), Youngstown, Ohio	Assoc. M.	April 7, 1915
	M.	Jan. 19, 1925
SUTHERLAND, Clarence Hale. Asst. Prof. of Structural Eng., Mass. Inst. Tech., Cambridge A, Mass.	M.	Jan. 19, 1925
TOVELL, Clarence Eugene. With G. Walter Tovell, S. W. Cor. Eutaw and Monument Sts., Baltimore, Md.	Jun.	Jan. 19, 1925
TOWNROW, Frederick Wazney. Designer Fort Pitt Bridge Works, Pittsburgh (Res., 115 Smithfield St., Canonsburg), Pa.	Assoc. M.	Dec. 15, 1924
VAN VALIN, Huestis Brown. Asst. Engr., City Water Dept., 215 Second St., Jackson, Mich.	Jun.	Aug. 4, 1924
WATKINS, Paul Langley. 1120 Mulberry St., Scranton, Pa.	Jun.	Jan. 19, 1925
WILLIAMS, Leon G. Draftsman, Sewerage Dept., City Engr.'s Office, Long Beach, Calif.	Assoc. M.	Dec. 15, 1924
WORCESTER, Robert Joseph Henderson. Superv. Engr. Lockwood, Greene & Co. (Res., 39 Hermitage Court), Charlotte, N. C.	M.	Jan. 19, 1925
WRIGHT, Stanley Hubert. Hydr. Engr., Box 24, Hendersonville, N. C.	Assoc. M.	Sept. 3, 1913
	M.	Dec. 15, 1924

Reinstatements

MEMBERS

	Date of Reinstatement
GEORGE, James Zachariah	Jan. 19, 1925
NICHOLS, Charles Sabin	Jan. 19, 1925
PARSONS, Harold Ashton	Jan. 19, 1925

ASSOCIATE MEMBERS

KNIGHT, Gerald Wilson	Jan. 19, 1925
McDOWELL, Floyd Francis	Jan. 19, 1925
THOMAS, Charles Randolph	Jan. 19, 1925

Deaths

DIVEN, John M. Elected Affiliate, September 10, 1891; died January 4, 1925.

DOUSMAN, James Hopkins. Elected Member, April 3, 1922; died January 5, 1925.

FARNUM, Henry Harrison. Elected Member, July 1, 1891; died December 23, 1924.

FREEMAN, Roger Morse. Elected Member, January 15, 1923; died January 20, 1925.

HOLMAN, Minard Lafever. Elected Member, April 2, 1884; died January 4, 1925.

MADDEN, John Henry. Elected Junior, October 7, 1902; Associate Member, May 4, 1904; Member, June 16, 1919; died January 22, 1925.

PRINCE, Arthur Dickson. Elected Junior, May 5, 1896; Associate Member, October 3, 1900; died January 21, 1925.
SCAIFE, William Lucien. Elected Member, December 3, 1890; died December 3, 1924.
SOULE, Howard. Elected Member, March 17, 1869; died December 10, 1924.
TABLER, Judson Gilman. Elected Member, December 6, 1920; died December 28, 1924.
WHINERY, Samuel. Elected Junior, April 1, 1874; Member May 4, 1881; died January 14, 1925.
WINSLOW, Benjamin Emanuel. Elected Member, October 7, 1907; died November 24, 1924.

Total Membership of the Society, February 3, 1925

Members	**4 952**	
Associate Members	**5 356**	
Corporate Members		**10 308**
Honorary Members		**13**
Juniors		**764**
Affiliates		**158**
Fellows		**8**
Total		**11 251**